Wetland Assessment of the Whitewater Watershed

Prepared for:

Malta Field Office,
U.S. Bureau of Land Management
Malta, Montana

By:

Elizabeth Crowe and Greg Kudray

Montana Natural Heritage Program
Natural Resource Information System
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Executive Summary

The Whitewater watershed is located in Phillips County near the boundary of the Northern Great Plains prairie pothole region in north-central Montana. The BLM partnered with the Montana Heritage Program to conduct a wetland and watershed health assessment. Methods will be refined next year and applied to the nearby Cottonwood watershed.

A broad scale GIS assessment and a fine scale field determination of proper functioning in individual wetlands were integrated to provide a comprehensive analysis of the watershed. A watershed profile was developed that characterized some presettlement conditions and postsettlement land cover, vegetation communities, land use, ownership, disturbance type/intensity and wetland/riparian site and buffer characteristics. Field sampling data were used to further characterized wetlands in the watershed and evaluate wetland health at the site level.

Most potholes in this area are relatively shallow and usually dry during the growing season. Although there are thousands of individual potholes, only 5% of the total land area is wetlands. Native grasslands are the dominant land cover, and cattle grazing is the primary use, although there are significant amounts of cropland on private lands. The BLM owns 57% of the land within the watershed. An examination of presettlement conditions using Government Land Office original survey notes revealed dams along the Whitewater drainage but did not record whether these were beaver or human caused. An incisement of 15 – 20 feet over the last century was calculated for the Milk River channel.

No plant species of concern had previously been recorded for the Whitewater watershed, however we did locate a new occurrence of a Montana state species of concern, poison suckleya. This is only the fourth reported occurrence in the state and the plant has the highest conservation rating of S1. Three records of animal species of concern were found in the Heritage database for the Whitewater watershed: Swift Fox, Ferruginous Hawk and Western Hognose Snake. Several other animal species of concern are associated with the prairie pothole landscape including Northern Leopard Frog, Plains Spadefoot, Great Plains Toad, Black-crowned Night Heron, White-faced Ibis, Franklin's Gull, Common Tern, Forster's Tern, and Black Tern. American White Pelicans also feed extensively on Tiger Salamanders found in prairie potholes. Prairie potholes are extremely important habitat for an incredible variety of creatures.

Although there have been modifications to the wetlands and the watershed as a whole, the Whitewater watershed is in better condition than most other watersheds in the prairie pothole region of North America. A relatively high composite score of 3.4 (on a 0 – 4 scale) was obtained through the GIS analysis of watershed characteristics related to wetland/riparian disturbance and landscape integrity. An analysis of land use along wetlands and streams indicated that 85 – 90% of the surrounding land was still in natural cover which represents a relatively intact upland – wetland contact area. Over 75% of the watershed is still in the natural land cover. Few of the permanent streams had impoundments, although the data did not allow analysis of ephemeral streams where most impoundments occur.

Codes on NWI mapping, which is from the 1980s, were used to determine that 6% of Palustrine wetlands have been impounded and 2% have been excavated, ditched or drained. Field sampling indicated that actual disturbance impacts have been considerably greater. About 70% of the pothole sites and 56% of the wetland acres surveyed during field sampling were considered to

be in proper functioning condition; hydrologic modification for stock ponds was the primary cause for wetlands functioning at risk. Reservoirs were assessed for proper functioning conditioning by the BLM; only 38% of these were rated in proper functioning condition. The discrepancy between the NWI and field sampling wetland disturbance percentages are likely due to a number of factors including increased hydrologic modification since the 1980's NWI mapping and modification that is evident at the site (e.g. road encroachment, chisel plowing adjacent to sites, etc.) but is too inconspicuous to register during the NWI aerial photo interpretation process.

The Whitewater watershed is remarkably free of weeds (compared to similar landscapes) except in areas where the sod has been broken for cropping or otherwise disturbed. Exotic plant species occur but only one noxious species, Canada thistle, was recorded in the wetland sampling. About 30% of the potholes sampled had exotic species; the average cover value was 2.7%. Sampled reservoir sites had higher exotic species occurrence (52%) and average cover (11%).

In general, the Whitewater watershed represents an excellent example of a prairie pothole landscape that is not only an uncommon ecosystem in Montana, but is also in good quality condition. The Nature Conservancy (1999) has recognized it as a conservation portfolio site. However, threats such as continued hydrologic modification, increased gas, agricultural or road development, noxious weeds, and overgrazing have the potential to degrade this landscape into conditions that are unfortunately all too common across the Northern Great Plains Prairie Pothole Region.

ACKNOWLEDGMENTS

Thanks for Dennis Lingohr, Rich Adams and Jon Kautt, Bureau of Land Management, Malta Field Office, for supplying data and information about the prairie potholes of the Whitewater watershed.

We thank Marc Jones for initial assessment of field data and for compiling the interim report for the 2002 field season and Jon Pierce (contractor) for conducting the initial year of field sampling of natural potholes. We thank Coburn Currier for report formatting and production and Whitney Weber for producing the maps.

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Table of Contents

List of Figures

List of Tables

INTRODUCTION

The prairie pothole region of North America (Figure 1) is unique and significant on both a national and global scale (Weller 1981, Mitsch and Gosselink 1993), yet potholes can be so common in some landscapes that perspectives about value are clouded by their mere abundance. Potholes have been routinely destroyed through drainage for crop production throughout their range (Hiemlich and Langner 1986), and many others have been degraded, typically due to the dominant agricultural use of surrounding uplands. Over half of the original 8 million hectares of wetlands have been destroyed in this region (Tiner 1984, Dahl 1990, Dahl and Johnson 1991).

Figure 1. Extent of Prairie Pothole Region in North America (from Euliss et al. 2002; used by permission of authors).

Concentrations of prairie potholes are uncommon in Montana and only occur in scattered pockets along the northern edge of the state. Additionally, most of these pothole wetland ecosystems have experienced fates similar to potholes across North America and have been destroyed or severely degraded (Lesica 1987). The Whitewater watershed in northern Phillips County has been identified as one of five significant areas in Montana where these ecosystems occur (Lesica 1993). The Nature Conservancy (1999) has recognized the Whitewater wetlands complex as a conservation target. This area is also at the very southwestern edge of the prairie pothole region (Figure 1), a setting that indicates proximity to a climatic and geologic ecotone where ecosystems may have unique characteristics and are also especially vulnerable to climatic or anthropogenic disturbances.

Although potholes are abundant in the Whitewater watershed, there is little information readily available on the ecology and condition of these wetlands. Most ecological information on prairie potholes has been developed from studies further east, primarily in North Dakota where climatic and landform conditions are considerably different. Montana potholes are generally much dryer with standing water only present in perhaps one year of five. Agriculture is common throughout the area on private land and the pothole wetlands within are likely impacted by the same forces of sedimentation, pollution, and nutrient enrichment that are so common and damaging throughout the prairie pothole region of North America. Bureau of Land Management (BLM) ownership represents the only considerable extent of public ownership and also native grassland matrix within the watershed. As part of an assessment of the Whitewater watershed, the BLM Malta Field Office requested an assessment of wetlands in the watershed.

Most of the potholes in the Whitewater watershed are very small (< 1ha.) and are clustered in certain areas of the watershed. Virtually all are grazed and many have been considerably altered hydrologically (impounded or excavated) to provide stock ponds or wildlife habitat. The small

size, abundance and isolated nature of these wetlands make assessment of individual wetlands most meaningful when interpreted on a landscape or regional scale. The approach in this study was to field sample individual pothole ecosystems to characterize the range of conditions present and to assess wetland health through completing a proper functioning condition assessment (Pritchard et al. 1999). Results from field sampling numerous sites across the watershed were combined with a broad-scale GIS analysis so that an assessment could be made of landscape condition and health. Threats to the proper functioning of pothole wetlands at individual sites and across the landscape were evaluated.

Land ownership in the Whitewater watershed is predominantly federal, and managed primarily by the BLM. There is also a substantial amount of private land and several state sections. Most of the land is still in native prairie and is used for cattle grazing on both public and private land. Much of the remaining land is either fallow or used for small-grain cropping.

The Ecological Setting: Climate, Geology, Landform, Soils, and Hydrology

The Whitewater watershed (Figure 2) is within the Northwestern Glaciated Plains Ecological Section that includes level to gently rolling continental glacial till plains and rolling hills underlain by soft marine shale (McNab and Avers 1994). They describe fire and drought as the primary sources of natural disturbance and summarize the land use as primarily cropland and grazing.

Climate

The climate of northeastern Montana is relatively cool and dry. In the town of Whitewater, the average yearly maximum temperature is 53.2 deg. F and the average minimum is 24.8 deg. F. July and August are hot with high temperatures averaging 85 deg. F. Temperatures in January average 11 deg. F. Average precipitation is 10 inches and average snowfall is 15 inches. In Loring to the northwest, precipitation is higher, averaging 12 inches, and snowfall averaging 25 inches. Winds average 11 miles/hour and are generally from the northwest throughout the year (Western Regional Climate Center 2003). Overall, precipitation is lower than in most of the prairie pothole region to the north and east of the study area.

Geology, Landform and Soils

Bearpaw and Claggett shale bedrock and the Judith River Formation sandstone bedrock underlie most of the watershed (Bergantino 2003). An inland sea that existed between 135 and 75 million years ago during Cretaceous times covered this entire region. Finer textured silts were deposited further into the lake eventually consolidating and forming shale. Heavier sands were deposited closer to shore in an environment that was often marshy. These deposits consolidated into sandstone bedrock mixed with soft shale and occasional coal strata from ancient marshes – now collectively called the Judith River Formation.

The underlying bedrock can affect the surface in a variety of ways including groundwater influence, as a parent material for residual soils, and landform shape. However, in glaciated landscapes like the Whitewater watershed, the influence of glaciation is much more important. The continental Pleistocene glaciers that covered this area left only about 11,000 years ago and deposited the glacial till that created the soil parent material and landforms that are present today. The depth of till in the area is probably similar to that noted for adjacent Blaine county where it ranges from a few to about 200 feet deep (Hilts 1986). Melting glacial ice blocks and the differential deposition of

Figure 2. Location of Whitewater Watershed

till created rolling hills and the isolated basins that became prairie potholes.

Glacial deposits have produced a variety of soils in Phillips County and the Whitewater watershed. Gravel and stone deposits are common in some areas due to glacial streambeds or outwash areas but the dominant textural matrix is silt or clay loams (Smith 1968). Agricultural potential is also limited by the topographic relief left by glacial deposition or by soils shallow to the till substratum (Smith 1968).

The high silt and clay content in pothole soils acts to limit infiltration in potholes when moist, but during dry periods secondary cracks develop that allow rapid infiltration rates. Runoff from the spring snowmelt may result in surface water levels much higher than a similar runoff event due to a rainstorm in the summer because the deep soil frost results in a nearly impermeable soil (Winter 1989).

Hydrology

Hydrology is inextricably linked to landform, climate and soils in all wetlands and the linkages in prairie potholes are especially clear. The rolling prairie landscape lacks well-defined drainage channels out of the trapped basins due to the low velocity and amount of surface runoff. The dominant fine-textured soils have low permeability rates that limit infiltration both in the depression and in the surrounding uplands (Winter 1989). Soil frost is often deep; spring runoff from the surrounding catchment will accumulate in the pothole without infiltration until the ground thaws. In a North Dakota study precipitation and snowmelt were the primary source of water and evapotranspiration was the principal source of water loss (Shjeflo 1968), a relationship probably true in our study area also. Our semiarid climate results in evapotranspiration rates much greater than precipitation input, thus most of the potholes in the Whitewater watershed are quite dry throughout the year and hold appreciable amounts of water probably only about 1 or 2 years in every five when precipitation is above average. Extreme variability is often the norm since drainage basins are small with hydrology strongly dependent on the annual vagaries of precipitation and evaporation.

The hydrology of prairie potholes is more complex than simply water exchanges with the atmosphere; there are interactions involving both surface and groundwater (Winter and Rosenberry 1995). Subsurface flow has long been documented (reviewed by Winter 1989) with observations of water retention for significant periods after what would be expected given just surface input and evaporation (Winter and Rosenberry 1995). Groundwater flows can also seasonally reverse; water can discharge from the wetland during the spring then reverse during the summer as evapotranspiration creates a sink for groundwater (Winter 1989).

Landscape dependent groundwater and surface water relationships also occur in prairie potholes with topographically lower wetlands receiving water and chemicals from wetlands higher on the landscape (Sloan 1972, Labaugh 1989, Winter 1989, Rosenberry and Winter 1997, Winter and Rosenberry 1998). Surface water can spill into topographically lower depressions and increase electrical conductivity and salinity (Leibowitz and Vining 2003). This hydrologic connectively can be ecologically controlling since salinity, along with the time and depth of standing water, are two primary ecological factors controlling plant distribution (Stewart and Kantrud 1971) and invertebrates (Euliss et al. 1999) in prairie potholes.

Wetland vegetation types occurring in potholes indicate the range of hydrologic function occurring there. Potholes that are classified as temporarily flooded tend to recharge groundwater, those that are seasonally flooded can have either a groundwater recharge or flow-through function,

and those that are semipermanently flooded can have either a flow-through or groundwater discharge function. Potholes that are highly saline are mostly groundwater discharge sites (Euliss et al. 1999).

The Ecological Functions and Human Values of Prairie Potholes

Prairie potholes are well recognized for their value as critical breeding habitat for waterfowl but numerous other species also depend on this habitat. Invertebrates are critical food chain support for many species of birds and a wide variety of other organisms in addition to affecting nutrient dynamics, sediment chemistry and wetland productivity (Euliss et al. 1999). Invertebrates have adapted to the wet/dry cycles in potholes forming communities that become more diverse with increased water permanence (Euliss et al. 1999). They form the main food source and are the critical source of nutrients for breeding waterfowl. Invertebrates are influenced not only by water level fluctuations but also by climatic conditions, vegetation and anthropogenic disturbances like sedimentation (Euliss et al. 1999).

Prairie potholes also provide important habitat for many amphibians. Frogs, toads, turtles and salamanders are all dependent on water in potholes for all or part of their life cycle. Some of these species are "of concern" for Montana such as the Northern Leopard Frog (*Rana pipiens*), Plains Spadefoot (*Spea bombifrons*), and Great Plains Toad (*Bufo cognatus*). The Western Hognose Snake (*Heterodon nasicus*), although not directly dependent on wetlands, feeds on toads, which are dependent on standing water for at least part of their lifecycle. Species "of concern" have particular threats, declining population trends, or restricted distribution that warrant special attention.

Prairie potholes are also important for a number of bird species. They are considered to be the most important breeding habitat for waterfowl in North America with production estimates ranging from 50% to 80% of the continent's main species (Batt et al. 1989). However, the extreme variability in climate and thereby pothole water levels also results in extreme population fluctuations in waterfowl populations. In addition to waterfowl, prairie wetland support a diverse assemblage of water dependent birds including Montana species of concern such as the Black-crowned Night Heron (*Nycticorax nycticorax*), White-faced Ibis (*Plegadis chihi*), Franklin's Gull (*Larus pipixcan*), Common Tern (*Sterna hirundo*), Forster's Tern (*Sterna forsteri*), and Black Tern (*Chlidonias niger*). American White Pelicans (*Pelecanus erythrorhynchos*) feed extensively on tiger salamanders (*Ambystoma tigrinum*) found in prairie potholes.

The small mammal community in prairie wetlands in Montana is primarily composed of five species: masked shrew (*Sorex cinereus*), muskrat (*Ondatra zibethicus*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), deer mouse (*Peromyscus maniculatus*), and meadow vole (*Microtus pennsylvanicus*) (Fritzell 1989). Meadow voles have dramatic population cycles of around 3 – 5 years and are typically the most abundant small mammal. Small mammals are an important food source for many prairie predators. Dense grass cover is important in providing small mammal cover; the heavier vegetation cover natural to pothole wetlands may serve as a population reservoir if grazing is managed well. Since bats are obligate insectivores, they are probably influenced by the abundance of insects associated with potholes although their distribution may be more affected by the availability of suitable roosting sites.

Prairie potholes are also important habitat for larger mammals including red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), raccoons

(*Procyon lotor*), mink (*Mustela vison*), weasels (*Mustela spp.*), striped skunks (*Mephitis mephitis*), and deer (*Odocoileus spp*.). Potholes represent both a source of food and cover. Predators like foxes and raccoons have a considerable effect on waterfowl breeding success; the spread of raccoons into the prairie has been regarded as a major influence in the marked decline of waterfowl nesting success over the last half century.

The amount and type of vegetation associated with potholes affect invertebrate habitat, hydrology, primary productivity, decomposition, and a wide variety of other ecological functions and human values. Pothole vegetation is used directly as food or habitat for many animals in the prairie including cattle. Although the potholes in this area are relatively dry compared to those found elsewhere, conditions support much more forage production than the surrounding uplands.

Prairie Pothole Wetland Habitat and Vegetation Classification

The flora of a prairie wetland depends on its water regime, salinity, and human disturbance (Kantrud et al. 1989). Specific vegetation communities often dominated by only one species can be recognized growing in the concentric zones of deeper pothole basins in correspondence to the water table depth and its persistence. Shallower basins may only have one or two vegetation zones but a zoned transition from low meadow vegetation to an aquatic community will occur in deeper basins. Salinity has a profound effect on pothole vegetation with decreasing numbers of species present as salinity increases (Kantrud et al. 1989). Human caused disturbance is widespread but varies in intensity and effect.

Potholes can be classified based on their habitats and/or their vegetation communities. Vegetation classification systems are based on dominant and characteristic plant species' composition and structure. These species groups serve as indicators of the environmental conditions, both regionally and site-specific, in which they occur. Habitat classification systems reflect the underlying gradients of hydrology and salinity that are strongly related to vegetation composition and may incorporate structural attributes of vegetation.

The National Vegetation Classification System (NVCS) (NatureServe 2002) has been adopted as the national standard for vegetation classification and is used by the Montana Natural Heritage Program (MTNHP). New vegetative associations, the finest level of detail in the NVCS, are still being described and refined in Montana by the MTNHP as needed. Plant associations are assigned ranks based on their conservation priority for a global and state basis. The NVCS has also identified a Northern Prairie Pothole Wetland Complex (see Appendix C for a complete description), which describes vegetative communities and environmental processes for the prairie pothole landscape mosaic.

There are two widely recognized wetland habitat classification systems by Stewart and Kantrud (1971) and Cowardin et al. (1979) that we can apply to the potholes in the Whitewater watershed. The National Wetland Inventory (NWI) uses the Cowardin et al. (1979) classification. Definitions of classification levels for these two habitat classifications are shown in Tables 1 and 2 in Appendix B.

Stewart and Kantrud (1971) characterized several wetland vegetation zones and the hydrologic phases typical of each zone. Each vegetation zone is also subdivided into one to several salinity subclasses. Cowardin et al. (1979) developed a hierarchical classification with several levels based on amount of vegetation cover or substrate (where vegetation cover is less than 25%) and relative length of flooding during the year. They also used special modifiers to denote salinity and hydrologic modification.

Assessing Wetlands in a Watershed Perspective

Assessing watershed health requires a landscape perspective for a variety of reasons related to habitat and ecosystem stability. All ecosystems are dependent on the flow of energy and materials from other sources. Prairie potholes receive water, chemicals, and sediment from the surrounding landscape, sometimes through subsurface connections that may be affected by distant processes. Species usually depend on a mosaic of habitats and are also sensitive to the arrangement and condition of these habitats. Populations of species need a variety of suitable sites to avoid subtle degradation through genetic inbreeding or extinction when catastrophic disturbance affects a limited number of sites. Degradation of individual habitats can be unnoticed until the cumulative effects across a watershed have devastating effects.

A watershed-based wetland assessment should describe the past, the present, and future trends in ecological condition while also incorporating information about agents of change that can affect wetland health on a watershed scale. In this study wetlands were assessed on both a broad-scale and a fine-scale. Both have their limitations and complement each other, providing different assessment perspectives. Parameters useful in assessing the health of wetlands on a broad-scale within a watershed are changes from historic conditions: 1) in land cover or use within the watershed as a whole; 2) within buffers around wetlands (both lentic and lotic); and 3) within the wetlands themselves. These changes can be incorporated into an index useful in assessing the general condition of wetlands within a single watershed and in comparing wetland condition in different watersheds to each other.

The BLM uses a national fine-scale assessment procedure in lentic wetlands (Pritchard et al. 1999). Hydrologic, vegetation and erosion/deposition characteristics of individual wetlands are assessed in the field and sites are given one of three functional rating: proper functioning condition, functional-at risk (with an upward, downward or non-apparent trend) or nonfunctional. Following an initial functional rating assessment, a more precise determination of wetland functioning may be obtained through quantitative analyses of data about soil, hydrology, or invertebrate communities. These quantitative analyses were not within the scope of this project.

METHODS

Broad-scale Remote Sensing Analysis of Wetlands

Remotely sensed data were used to assess the condition of wetlands on a watershed scale. Through GIS analysis, data were produced for summaries and determination of the Composite Wetland Condition Index (described below). The U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) digitized wetland map served as the base map for wetland class, size, distribution and current condition (Table 1). Additional digital data (Table 1) were: the U.S. Geological Survey (USGS) national landcover dataset; BLM allotment boundaries; land ownership; the USGS National Hydrography streams layer; and a modified 4th-code HUC (hydrologic unit code) boundary for the Whitewater Watershed (the northwestern boundary was abbreviated to correspond to the BLM management area). Using these input GIS layers, values used in the Composite Wetland Condition Index (CWCI) for the Whitewater Watershed were calculated based on methodology developed by the Northeast Region of the National Wetland Inventory Program (Tiner et al. 2000).

Data used in calculating the sub-indices within the CWCI were derived as follows:

Natural Cover Index

- sum the landcover categories within the watershed boundary from the USGS national landcover dataset

Stream Corridor Integrity Index

- buffer the stream segments in the 1:100,000 USGS streams layer, then
- overlay the buffers on the national landcover database layer, then
- sum the acreages of landcover categories within the buffer areas

Lentic Wetland Buffer Index

- buffer all mapped lentic wetland polygons in the NWI wetland map, then
- overlay the buffers on the national landcover database layer, then
- sum the acreages of landcover categories within the buffer areas

Dammed Stream Flowage Index

- overlay the NWI polygon layer on the 1:100,000 streams layer to determine which stream segments are diked or impounded, then
- sum the number of stream miles in these diked or impounded segments

Wetland Disturbance Index

- group NWI polygons that are mapped as having hydrological alteration (diked/impounded, partially drained/ditched or excavated) and those that have not been hydrologically altered, then
- sum the two categories

Field Data Collection and Fine-scale Assessment of Wetlands

Wetlands were assessed and given a functional rating (Pritchard et al. 1999). The MTNHP surveyed and assessed 65 sites consisting of one to several natural pothole wetlands. Sites were spread across grazing allotments, providing both a broad assessment of the watershed and comparisons among allotments. The BLM Malta Office assessed 114 reservoir wetlands, also scattered throughout the watershed. Wetlands were classified with the NWI (Cowardin et al. 1979) and Stewart and Kantrud (1971) systems.

Vegetative communities were tentatively classified and correlated to these types. All plant taxonomy follows Kartesz (1999). In addition, survey notes from the U. S. General Land Office (GLO) township surveys were obtained for comparison of current and historic resource conditions.

Table 1. GIS data layers used in remote sensing analysis

GIS Layer Name	Data Source	Remotely Sensed Imagery or Other Data Source Used; Date of Imagery Collection/Data Source Production	Useable Mapping Scale
National Wetlands Inventory	U.S. Fish and Wildlife Service, National Wetlands Inventory Program	1:24000 aerial photos: 1986	1:24000
National Landcover Dataset	U.S. Geological Survey, Biological Resource Division	30m pixel Landsat Imagery; 1992	1:60000
BLM Allotment Boundaries	BLM, Malta Field Office		1:24000
Land Ownership	BLM, Malta Field Office		1:24000
National Hydrography Dataset	U.S. Geological Survey, Montana Natural Resource Information Service	U.S. Geological Survey 1:24000 topo maps	1:100000
Whitewater HUC	Modified from U.S. Department of Agriculture, Natural Resources Conservation Service, Montana State Office	1:100000 base maps; 1996	1:100000

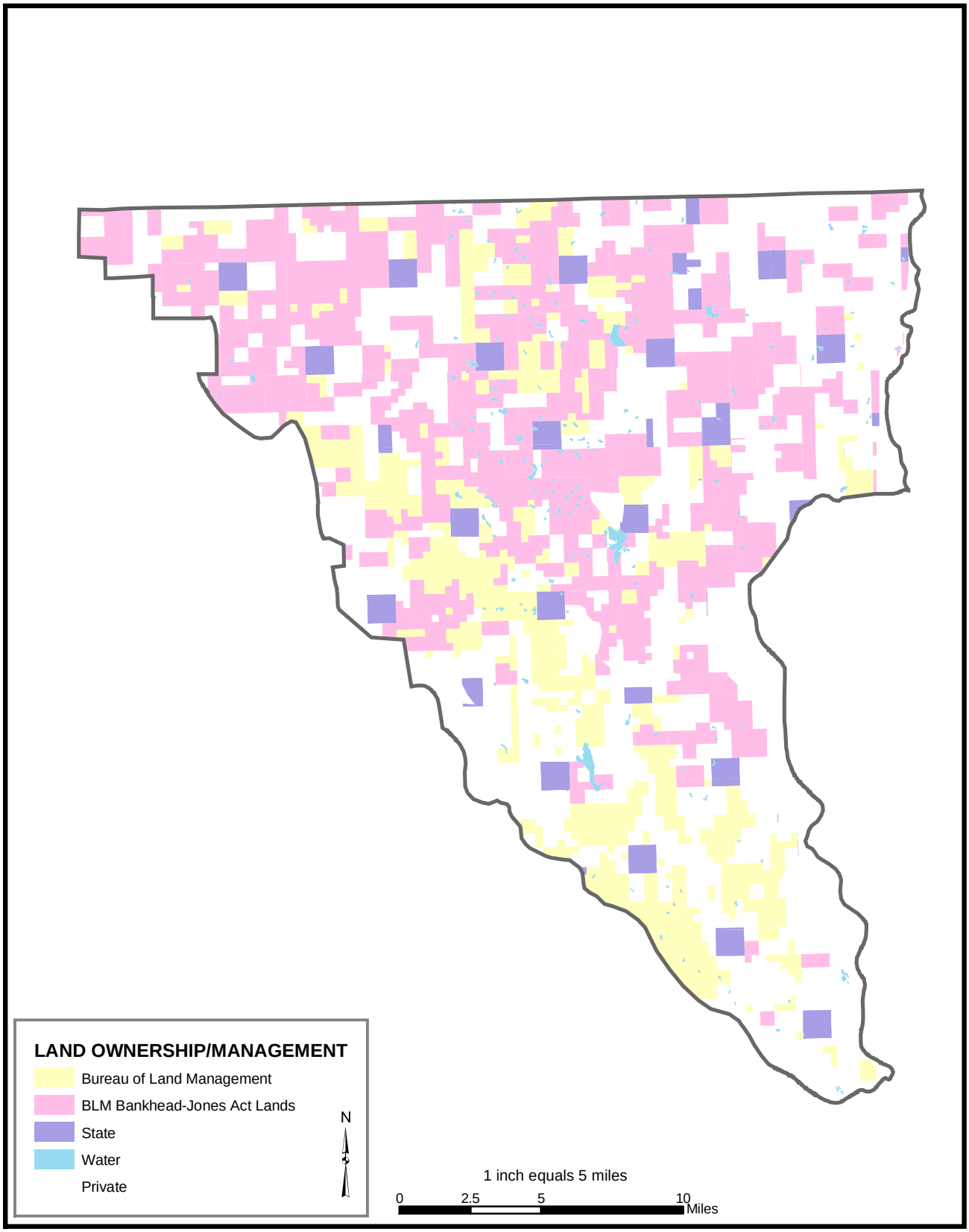

Figure 3. Land Ownership/Management within Whitewater Watershed (BLM and National Wildlife lands are federally owned.

RESULTS AND DISCUSSION

Broad-scale Assessment

Much of the watershed is presently under public ownership (Figures 3 and 4). A total of 57% is managed by the BLM (Figure 4). Most of the land

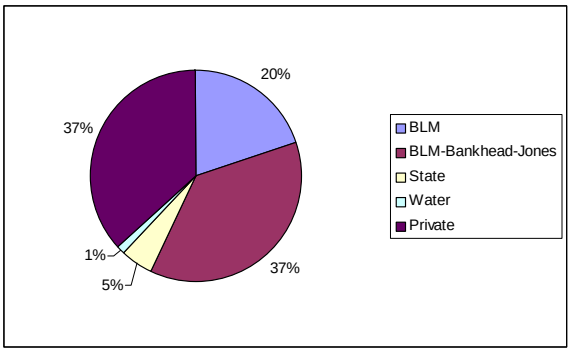

Figure 4. Percentage area in watershed by ownership

area is still in native grassland cover (Figure 5 and 6). The watershed encompasses 306,021 acres, of which 5% (15935 acres) are wetlands (this acreage is calculated from NWI mapping in the watershed and is greater than the 1% value shown in Figure 5, which is calculated from the USGS landcover dataset). Uplands comprise 95% of the

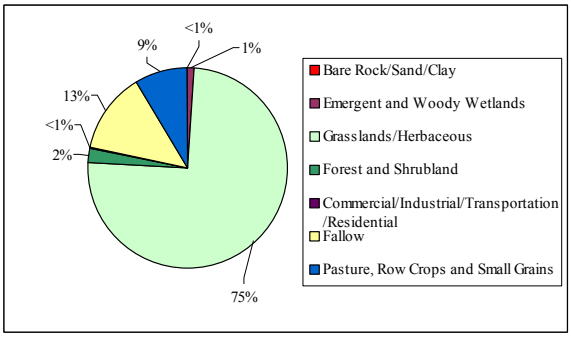

Figure 5. Percentage area in watershed occupied by natural landcover and human use categories (calculated from USGS landcover mapping, which is less accurate than NWI mapping and shows fewer acres of wetlands).

watershed (290086 acres). There are 203 miles of perennial and intermittent streams. Of the wetland acreage, 1746 acres are Lacustrine, 14031 acres are Palustrine and 158 acres are Riverine (Figure 7). Figures 8 and 9 (following pages) show the distribution of these wetland types.

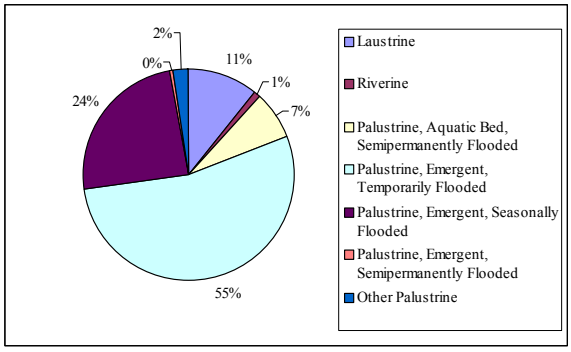

Figure 7. Percent acreage of wetland types in watershed

Most of the potholes in the Whitewater Watershed are classified as Fresh Wetland Low Prairie, Fresh or Slightly Brackish Wet-Meadow, or Fresh or Slightly Brackish Shallow-Emergent in the Stewart and Kantrud system (1971). In the NWI system most Whitewater potholes are classified primarily as Palustrine wetlands with emergent vegetation or aquatic beds that are temporally, seasonally or semipermanently flooded (Figure 10).

Figure 10. Natural pothole; Palustrine, Emergent, Seasonally Flooded

Factors and Magnitude of Wetland Change

The acreage of Lacustrine wetlands and Palustrine wetlands that either have aquatic beds or are

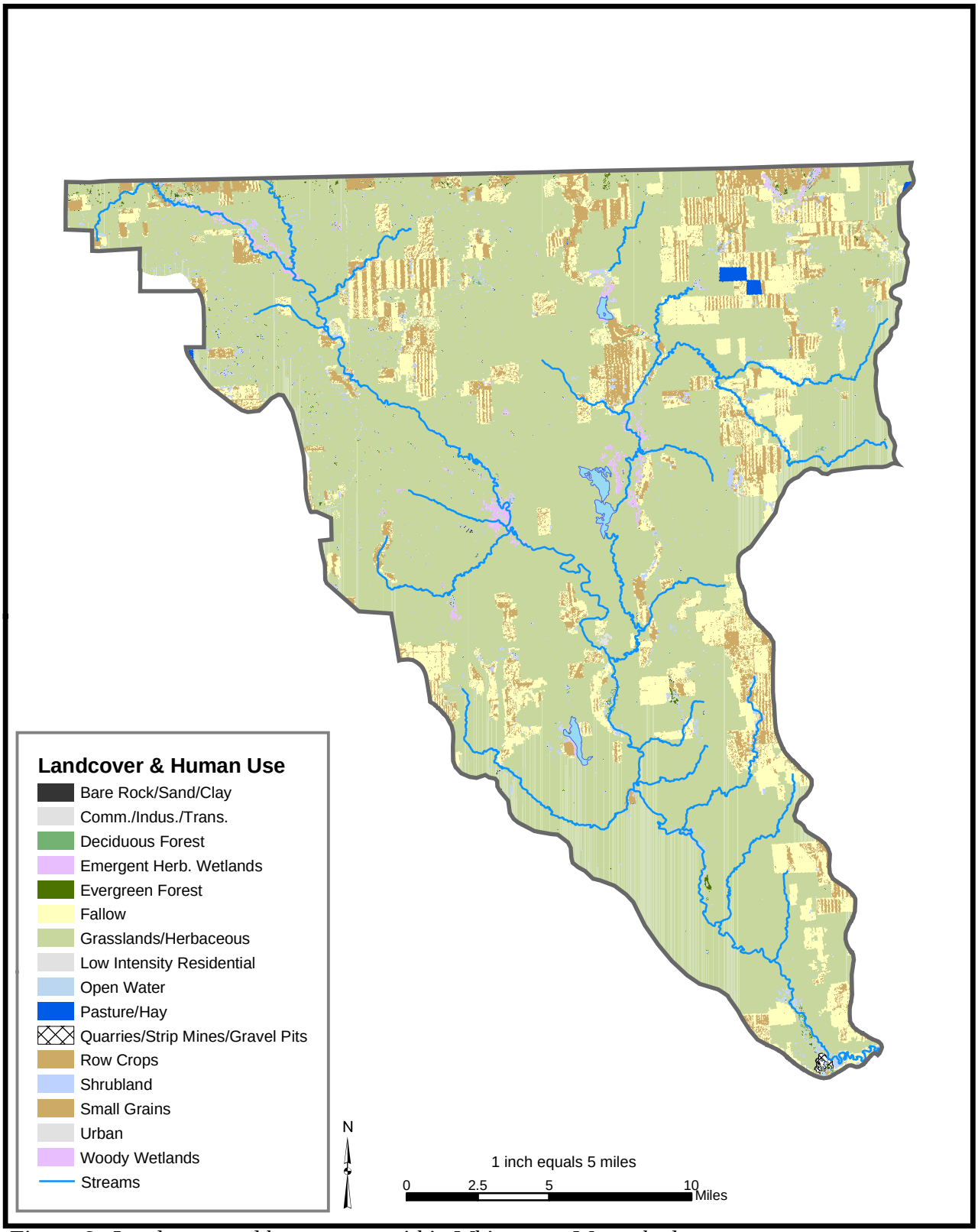

Figure 6. Landcover and human uses within Whitewater Watershed

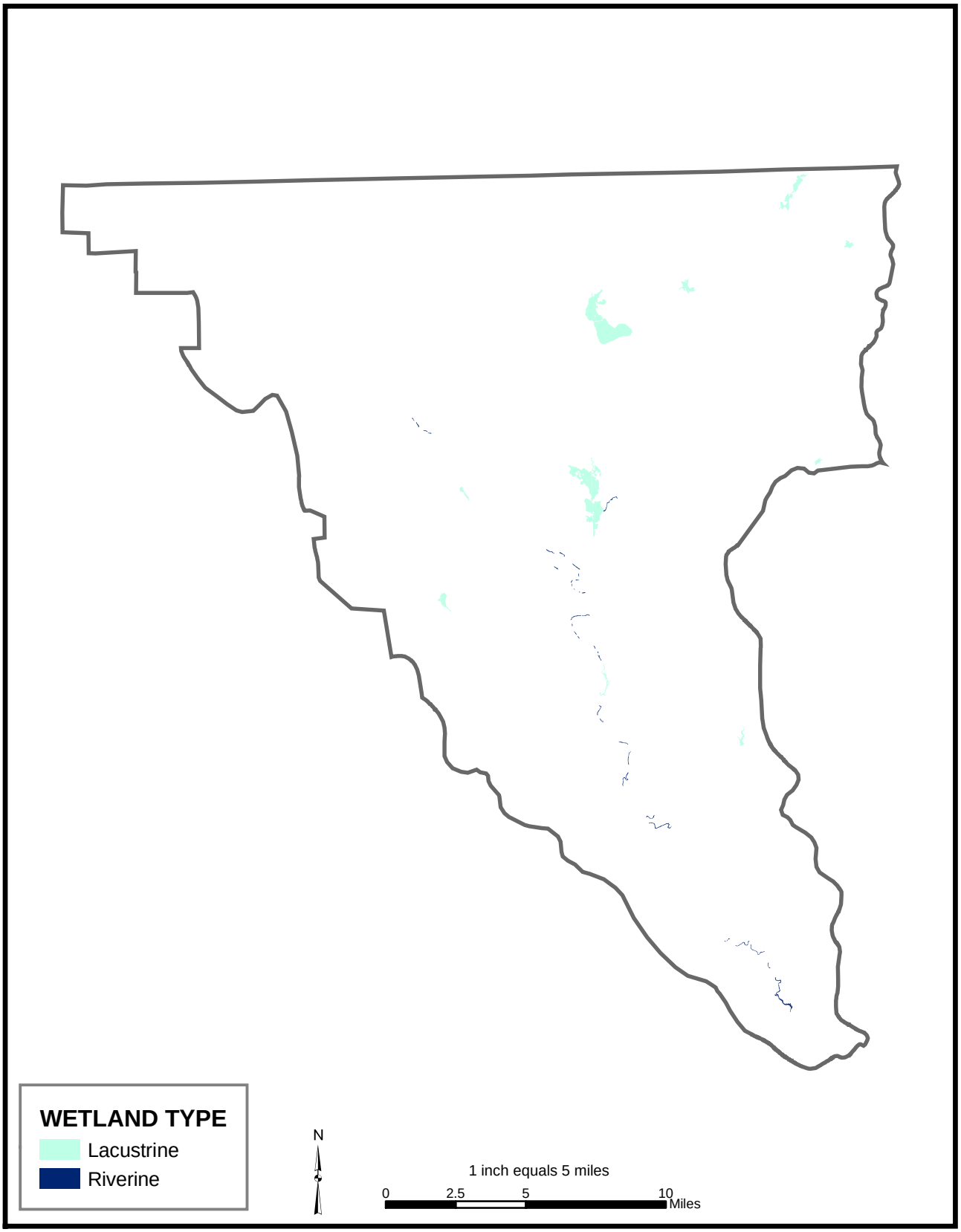

Figure 8. Riverine and Lacustrine Wetlands in Whitewater Watershed

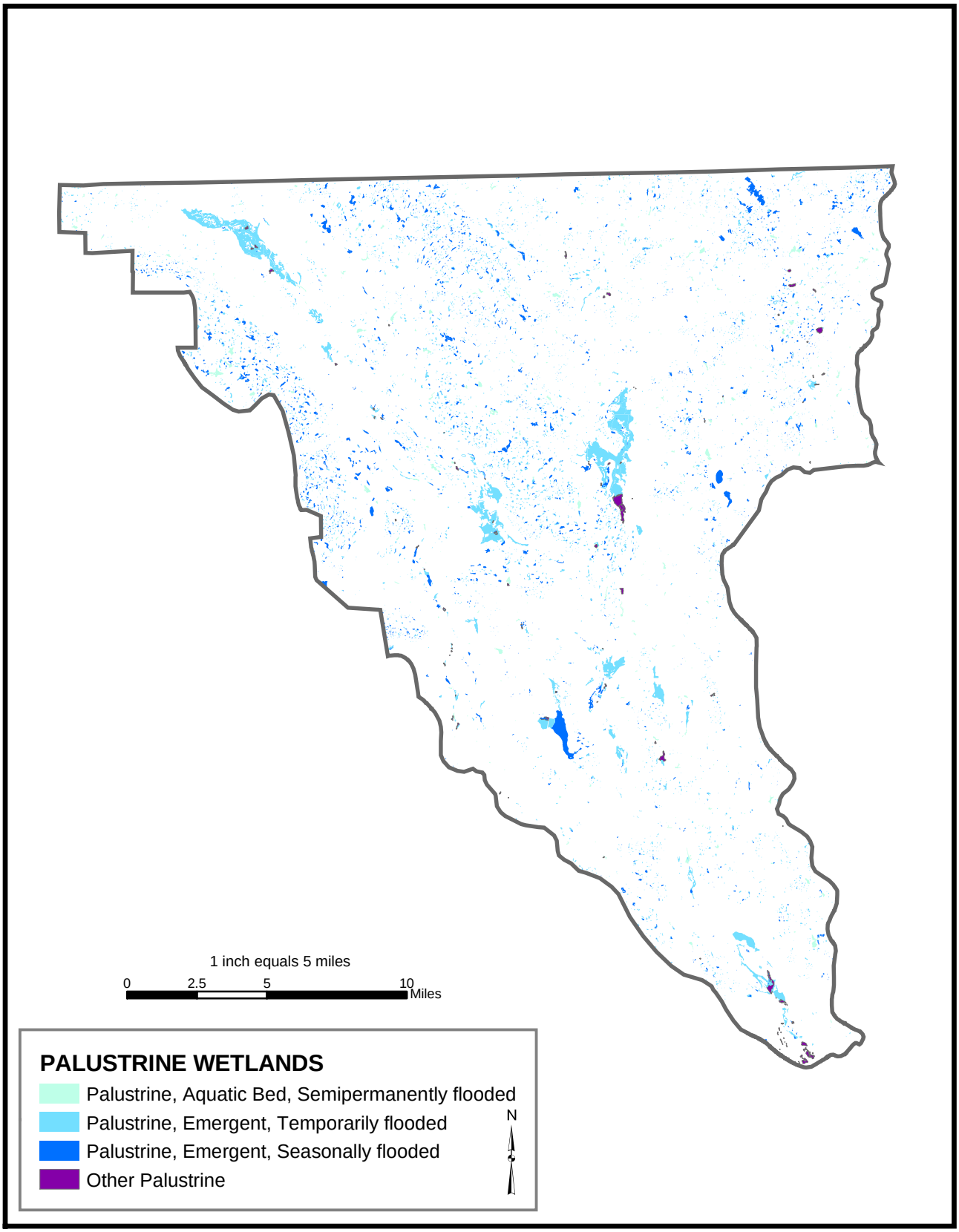

Figure 9. Palustrine Wetlands in Whitewater Watershed

semi-permanently flooded has increased since pre-settlement times as a result of excavation and impoundment of both potholes and stream reaches within the watershed. The lack of hydrologically altered Riverine wetlands does not mean that the streams have not been impacted by human activities. Any impounded streams would now be mapped as Lacustrine or Palustrine wetlands. Tables 3 and 4 in Appendix B show acreages and percent modification by NWI wetland classes.

Excavation, Ditching and Draining of Potholes

Two percent of the Palustrine wetland acreage has been excavated, drained or ditched based on NWI mapping (Figure 11). Fortunately, this is a small amount of the total Palustrine acreage in the watershed and is notable within the greater Prairie Pothole region of the United States and Canada where many watersheds have lost much of their wetlands. No baseline information on vegetation

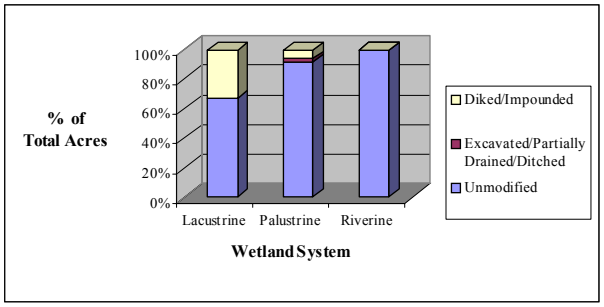

Figure 11. Proportions of hydrological modification in wetland polygons mapped by NWI

types or hydroperiods prior to excavation, draining or ditching exists, and thus it is difficult to say what the effect has been on the potholes, especially with respect to excavation. It is likely that excavation, while creating more permanent ponds on the landscape has decreased the area of standing water at excavated potholes. Runoff after snowmelt and precipitation events probably ends up in the ponds rather than remaining on the surrounding pothole surface. This would decrease the total acreage of seasonal pond habitat availability. At the same time, it may provide more habitat for some animals, especially waterfowl and wading birds that rely on more permanent bodies of water during their nesting and rearing seasons. Examples of excavation are shown in Figures 12 and 13. A small portion of the potholes in the

Figure 12. Excavated pothole

Figure 13. Moat excavation

Whitewater watershed has been ditched to drain water into other potholes or excavated pits (Figure 14). Some may be drained on private land to facilitate use of sites for row cropping or hayfields.

Impoundment of Potholes

Six percent of Palustrine wetlands are impounded. Most impoundments within the Whitewater watershed have been built in ephemeral and intermittent drainages, thus creating Palustrine or Lacustrine wetlands where there were either no wetlands or Riverine wetlands in the past.

Figure 14. Ditch draining water from pothole into excavated pit

Changes to the hydrology of the watershed due to these impoundment effects are impossible to determine without baseline data.

Agricultural Runoff and Sedimentation

Surrounding land uses always influence wetlands, and agricultural impacts can be severe even if the wetland itself is not drained or plowed. The position of potholes as low points on the landscape with minimal if any flow-through hydrology tends to concentrate impacts of sedimentation, nutrient enrichment, or herbicide/ pesticide pollution. Sedimentation from wind and water erosion is greater in an agricultural landscape compared to grasslands and can impair natural wetland functions or completely fill depressions and destroy the wetland over time (Gleason and Euliss 1998).

Agriculture, along, with water level fluctuations, has been the dominant factor affecting the distribution, abundance, and reproductive success of ducks in the prairie pothole region (Batt et al. 1989). Habitat loss through drainage and the conversion of native grassland to cropland has been the major impact of agriculture on waterfowl although other factors like fire suppression, erosion, and tillage have also affected waterfowl (Swanson and Duebbert 1989).

Invertebrates, a critical base of the pothole food chain and important ecologically in productivity and nutrient dynamics, are vulnerable to agricultural chemicals that can accumulate in wetlands (Grue et al. 1989). Other agricultural impacts like elevated sedimentation rates, unnatural variation in water-level fluctuations, nutrient pollution, and altered vegetation communities have unknown impacts on the ecology of pothole invertebrates (Euliss et al. 1999).

Based on our GIS analysis approximately 6% of the land surrounding lentic wetlands and 4% of the land surrounding perennial and intermittent streams is in active agricultural use (crops or pasture). This is a small amount of the watershed and, thus, the effects of sedimentation and nutrient runoff are probably low.

Road Encroachment

Unimproved roads, "two tracks", as well as higher standard paved and gravel roads, are not extremely abundant but do occasionally encroach upon potholes and other wetlands within the watershed. In some cases roads run directly through potholes (Figure 15) resulting in an absence of vegetation within the tracks or roadbed, an alteration of water flow within the potholes (often water is ponded adjacent to the

Figure 15. Road encroachment in pothole

road), soil compaction, and the opportunity for introduction of exotic species. Roads are often associated with gas developments.

Natural Gas Development

Natural gas extraction is prevalent within the watershed. Underground pipelines have occasionally been buried through potholes (Figure 16), possibly affecting the hydrology and also disturbing the soil and creating sites for exotic species establishment. Other impacts on wetlands

Figure 16. Gasline crossing pothole

by gas development in watersheds can be direct or indirect. Road establishment and well site construction and operation result in: soil compaction, loss of topsoil productivity, removal of native vegetation, introduction of exotic species, wind and water erosion of soils and, possibly, movement of sediment into streams and wetlands. Wildlife that use wetlands can be disturbed through the direct loss of habitat, (if roads or drilling occur directly within the wetlands) or displaced when disturbed by construction, drilling or road traffic either in or adjacent to wetlands (TRC Mariah Associates, Inc. 2000; USDI BLM et al. 2003).

Composite Wetland Condition Index

The following broad-scale assessment of wetlands is based on a procedure for assessing wetlands within a watershed that has been developed by the Northeast Region of the U.S. Fish and Wildlife National Wetland Inventory Program (Tiner et al. 2000). The procedure was adapted to better assess landscape and wetlands in the Whitewater watershed.

Values were calculated for several sub-indices of wetland health in a watershed and combined to determine an overall index, the Composite Wetland Condition Index (CWCI), for the Whitewater watershed. The four habitat extent indices determine how much of the original pre-settlement vegetative habitat still exists within the watershed with emphasis on habitat adjacent to wetlands, i.e. buffers. Buffers serve many ecological functions: sediment removal and erosion control, excess nutrient removal, moderation of stormwater runoff, and maintenance of habitat diversity. Effective buffer widths vary with respect to particular ecological functions (Castelle et al. 1994). Specific effective widths are not known for every function in the prairie pothole landscape, so we used three conservative widths for this assessment. The two disturbance indices determine how much wetland area has been altered since presettlement times. Each index ranges from 0.0 to 1.0. For the habitat indices, values closer to 1.0 indicate greater extent of intact habitat within the watershed. For the disturbance indices, values closer to 1.0 indicate greater disturbance of wetlands. The habitat indices are added together and the disturbance indices are subtracted from this sum to create the CWCI for the watershed.

Habitat Extent Indices

Natural Cover Index (I_{NC})
The natural cover index is a ratio of the amount of land area that is wooded or "natural" open land (not cropland, hayfields, quarries or homesteads) to the total land area in the watershed. Wetlands are affected by activities within the watershed as a whole. Human activities within watersheds can

strongly affect many aspects of wetland health including hydrology, water quality, vegetation composition, soil development, nutrient cycling and many other critical environmental factors. This index is important in determining how much area in the watershed may be contributing to changes in wetland function that are not within natural ranges.

$I_{NC} = A_{NV}/A_{W;}$ A_{NV} = area in natural vegetation; A_W = total area in watershed minus area occupied by open bodies of water (lentic and lotic)

For the Whitewater Watershed (Table 2):

$$\mathbf{I_{NC}} = 239{,}138/306{,}021 = \mathbf{0.78}$$

This score is relatively high and indicates that much of the watershed is still in natural landcover.

Stream Corridor Integrity Index (I_{SCCI})
The stream corridor integrity index indicates the amount of land within a given buffer on either side of all perennial and intermittent streams that is occupied by natural open land (Figures 17 and 18). Buffers (50m, 100m and 150m) were created around the stream segments mapped in the NRIS 1:100000 streams layer within the Whitewater watershed boundary. Thus, these

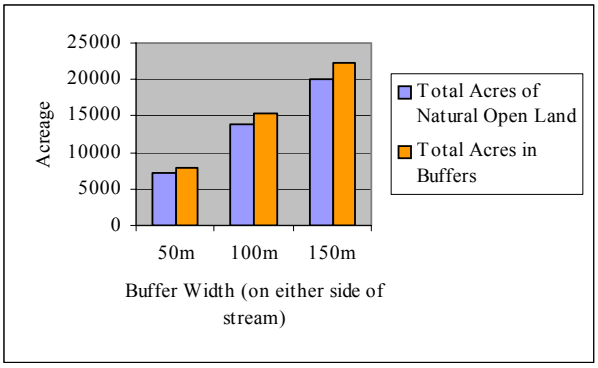

Figure 17. Natural landcover within stream buffers

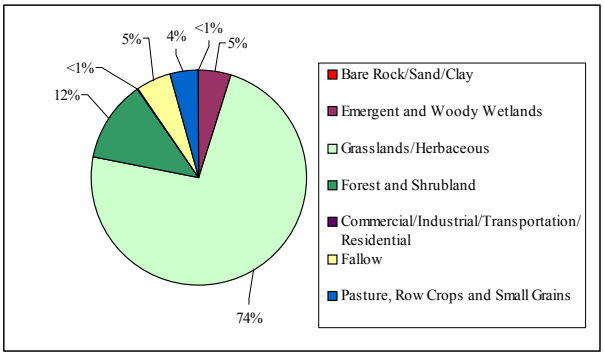

Figure 18. Proportion of generalized landcover categories within 100m buffer width

Table 2. Landcover and Human Use in Whitewater Watershed

Landcover Type or Human Use	**Acreage**
Natural Open Land	
Bare Rock/Sand/Clay	21
Emergent Herbaceous Wetlands	2,165
Woody Wetlands	850
Grasslands/Herbaceous	229,369
Shrubland	5,495
Deciduous Forest	451
Evergreen Forest	787
Total Acreage of Natural Open Land	**239,138**
Land Modified by Humans	
Commercial/Industrial/Transportation	150
Low Intensity Residential	37
Quarries/Strip Mines/Gravel Pits	143
Fallow	39,913
Pasture/Hay	626
Row Crops	119
Small Grains	25,895
Urban/Recreational Grasses	<1
Total Acreage in Watershed	**306,021**

buffers do not include the land within ephemeral drainages. This index is important in determining how much of the area adjacent to streams is contributing greater than natural amounts of sediment, pollutants and runoff. Croplands within stream buffer zones contribute more sediment than naturally vegetated areas (Wilkin and Hebel 1982). Roads and other commercial, industrial and residential development often compact soil, creating higher than natural runoff into streams. Table 5 in Appendix B gives acreages of NWI classes within the stream buffers.

$I_{SCI} = A_{VC}/A_{TC;}$ A_{VC} = vegetated stream corridor area (colonized by natural vegetation, see above); A_{TC} = total stream corridor area (minus area occupied by open water bodies)

For the Whitewater Watershed:

$$\mathbf{I_{SCI50}} = A_{VC50}/A_{TC50} = 7163.3/7854.2 = \mathbf{0.91}$$

$$\mathbf{I_{SCI100}} = A_{VC100}/A_{TC100} = 13817.2/15285.9 = \mathbf{0.90}$$

$$\mathbf{I_{SCI150}} = A_{VC150}/A_{TC150} = 19975.6/22310.2 = \mathbf{0.90}$$

These scores are all quite high, even within a 300m (total) buffer width, indicating that perennial and intermittent streams are probably not highly affected by the land uses categorized in this process. This result does not preclude influences of other, less obvious human activities or intensive impacts of developments within small acreages.

Lentic Wetland Buffer Index (I_{LWB})

The wetland buffer index indicates the amount of land that is occupied by natural open land within a given buffer width on either side of all lentic wetlands. Buffers (50m, 100m, and 150m) were created around the NWI polygons at three buffer widths (Figures 19 & 20). This index is important in determining how much of the area adjacent to wetlands is contributing greater than natural amounts of sediment, pollutants and runoff. Croplands within wetland buffer zones contribute

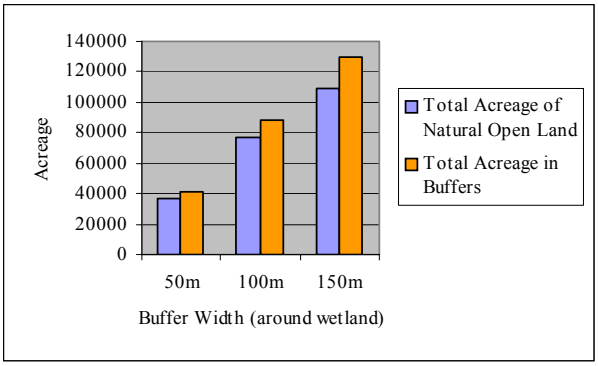

Figure 19. Natural landcover within wetland buffers

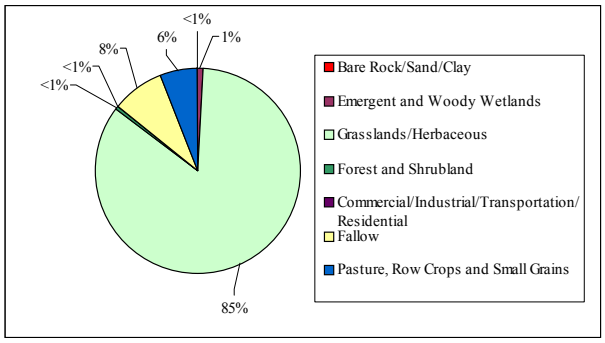

Figure 20. Proportion of generalized landcover categories within 100m buffer width

more sediment than naturally vegetated areas (Wilkin and Hebel 1982). Roads and other commercial, industrial or residential development often compact soil, creating higher than natural runoff into wetlands. Table 6 in Appendix B gives acreages of NWI classes within the wetland buffers.

$\mathbf{I_{LWB}} = A_{VB}/A_{TC}$; A_{VB} = vegetated wetland buffer area (colonized by natural vegetation, see above); A_{VB} = total wetland buffer area (minus area occupied by open water bodies)

For the Whitewater Watershed:

$\mathbf{I_{LWB50}} = 36416.4/41458.3 = \mathbf{0.88}$
$\mathbf{I_{LWB100}} = 76502.9/88919.8 = \mathbf{0.86}$
$\mathbf{I_{LWB150}} = 109493.7/129874.4 = \mathbf{0.84}$

Standing Waterbody Extent Index

The standing waterbody extent index measures the change in the areal extent of waterbodies within a watershed from presettlement to current times.

This index indicates the extent of human activities that result in the filling or draining of water bodies and therefore also the associated loss in the habitat and functions of open water bodies.

$I_{SWE} = A_{CSW}/A_{HSW;}$ A_{CSW} = current standing waterbody area; A_{HSW} = historic standing waterbody area in the watershed.

Extensive open waterbodies have been created, and the total area of open water has increased since pre-settlement times, so the maximum index value is used.

For the Whitewater Watershed:

$$\mathbf{I_{SWE}} = \mathbf{1.0}.$$

This index value indicates that land uses in this watershed have had virtually no impact on the areal extent of water bodies in the watershed.

Stream and Wetland Disturbance Indices

Dammed Stream Flowage Index (I_{DSF})
The dammed stream flowage index measures the ratio of dammed and free flowing streams within the watershed. This index is important in that the damming of streams beyond their natural range (by beavers or colluvial flows) changes the hydroperiodic flows within the watershed and can deprive perennial riparian vegetation of water necessarily for maintenance of communities.

$I_{DSF} = L_{DS}/L_{TS;}$ L_{DS} = length of mapped perennial and intermittent streams impounded by dams; L_{TS} = total length of perennial rivers and streams in the watershed

For the Whitewater Watershed:

$$\mathbf{I_{DSF}} = 7.1 \text{ mi}/203.1 \text{ mi} = \mathbf{0.03}$$

The low index value indicates that few miles of perennial and intermittent stream have been dammed. Most dams/impoundments in the watershed appear to have been built in ephemeral drainages or as impoundments of lentic wetlands. In using this index for future watershed-based wetland assessments, the calculated value would be more accurate with the addition of ephemeral stream channels to the streams layer.

Wetland Disturbance Index (I_{WD})
The wetland disturbance index is a ratio of the areal extent of hydrological disturbance of wetlands to the total acreage of wetlands in the watershed (Figure 21). This index applies only to lentic wetlands, typically prairie potholes, in the watershed.

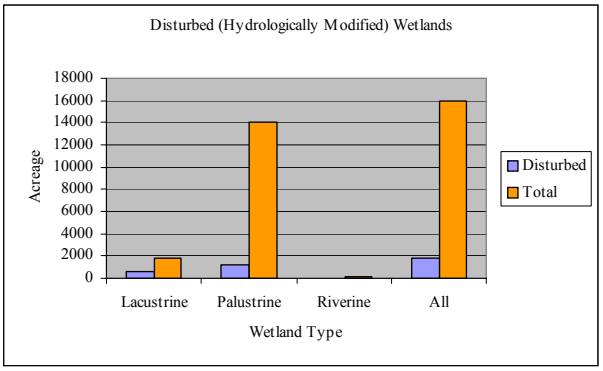

Figure 21. Acreage of Hydrologically Modified Wetlands

$I_{WD} = A_{DW}/A_{TW;}$ A_{DW} = area of disturbed or altered wetlands; A_{TW} = total wetland area in the watershed

For the Whitewater Watershed:

$$\mathbf{I_{WD\text{-}Lacustrine}} = 580.3/1745.8 = \mathbf{0.33}$$

$$\mathbf{I_{WD\text{-}Palustrine}} = 1190.3/14031.3 = \mathbf{0.08}$$

$$\mathbf{I_{WD\text{-}Riverine}} = 0/157.7 = \mathbf{0.00}$$

$$\mathbf{I_{WD\text{-}Total}} = 1770.6/15934.3 = \mathbf{0.11}$$

The index values calculated above reflect the creation of water bodies, mapped as Lacustrine wetlands by the NWI, in the watershed. Some disturbance of natural Palustrine wetlands has occurred, but a significant portion (as mapped by

the NWI) are still hydrologically unmodified. It should be noted that the lack of disturbance in the Riverine wetlands is somewhat misleading. Riverine wetlands that have been hydrologically modified, i.e. impounded, are now mapped as Lacustrine or Palustrine wetlands. These impounded acres, however, are accounted for in the $\mathbf{I_{WD\text{-}Total}}$

Composite Wetland Condition Index for the Watershed (I_{CWWI})

This index portrays the overall condition of wetlands within a watershed.

$$I_{CWWI} = I_{NC} + I_{SCI\text{-}100} + I_{WB100} + I_{SWE} - I_{DSF} - I_{WD\text{-}Total}$$

For the Whitewater Watershed:

$$\mathbf{I_{CWWI}} = 0.78 + 0.90 + 0.86 + 1.00 - 0.03 - 0.11 = \mathbf{3.4}$$

Ideally, if all habitat were available and there were no disturbance in the watershed, i.e. if the watershed were in pre-settlement condition, the composite index would be 4.0. All habitat sub-indices are greater than 0.75, reflecting the low amount of human development that has occurred. Low natural precipitation rates certainly inhibit extensive cropping and urbanization. The greatest disturbance impact has been the construction of impoundments as reflected in the Lacustrine portion of the Wetland Disturbance Index. Overall, the I_{CWWI} is high and indicates watershed wetlands in relatively good ecological health. It will be useful to compare this value for the Whitewater watershed to other watersheds in the prairie pothole region. This index can be readily calculated and can be modified to more precisely reflect disturbance factors (e.g. fragmentation, road networks, etc) prevalent in other watersheds.

Fine-scale Assessment

Presettlement Condition

During the last few millennia, grazing in the Whitewater watershed was dominated by American bison (*Bos bison*), elk (*Cervus elaphus*) and pronghorn (*Antilocapra americana*), the latter having much less impact that the first two on vegetative structure, composition and production. The plant species commonly found in the grasslands that dominate the watershed are well adapted to the intense short term grazing regime of bison and elk. Native human populations lived, hunted and traveled through the watershed, using the natural resources. Their effect on the wetlands, both lotic and lentic, may have been minimal as there are no obvious signs of prehistoric drainage, excavation or impoundment of wetlands or bodies of water. Beavers were abundant and influential on stream flow in Whitewater Creek and its tributaries. Since these are fairly narrow streams, beavers are able to build small dams, which decrease sediment movement and water flow, creating more perennial reaches and broader low floodplains.

Beginning in the mid 1800s, Euro-American settlers began moving into the southern part of Phillips County and establishing homesteads on which they farmed and ranched. The main portion of the Whitewater watershed was settled from about 1906 to 1918 (Montana Water Resources Board 1968). Native prairie and some bottomlands were converted to crops and pasture in a portion of the watershed. Most of the rest was used as grazing areas for livestock. The practice of hydrologically modifying streams and potholes to benefit agricultural began. Thousands of acres of homesteads were bought back by the U.S. government from failed dryland farms under the Bankhead-Jones Act.

Numerous sites along Whitewater Creek and the Milk River were visited to compare GLO survey notes with present-day (post Euro-American settlement) conditions. GLO surveys occurred in the early 1900's in the upper part of the Whitewater watershed, after settlement had already begun, so they do not represent a reliable pre-settlement baseline. For example, at some sites, the notes mention dams along Whitewater Creek but do not specify whether humans or beavers built the dams. However, GLO notes dated back to the late 1890's for locations along the Milk River and we were able to verify significant changes in hydrology and geomorphology at those locations.

The Milk River is dammed upriver from its confluence with Whitewater Creek near Havre (Fresno Dam). This dam has decreased the rate of channel meander, decreased channel width and caused the channel bed to incise (Jones 2003). The channel incision has isolated the former floodplain. We compared the GLO survey notes from the late 1890s, which give horizontal and vertical distances from a permanent benchmark to the river bottom, far bank and floodplain surface, to the current channel morphology. The notes clearly describe the location of this historic floodplain which is now located approximately 15 to 20 vertical ft. above the present day floodplain. Figures 22, 23, and 24 show the location of the historic floodplain that is still populated by a declining stand of plains cottonwood (*Populus deltoides*). This incision, caused by a lack of sediment transport and a reduction in flood discharge quantities after dam construction, has had a detrimental effect on cottonwood regeneration along the Milk River (Jones 2003).

Figure 22. Milk River – edge of historical floodplain

Figure 23. Milk River – edge of historical floodplain

Figure 24. Milk River – GLO Reconstruction

PFC Assessment of Lentic Wetlands

Figure 25 (following page) shows the locations of the 179 wetland sites surveyed and assessed in the

Whitewater watershed. Nineteen of the 65 natural pothole wetland sites surveyed were considered to be functioning-at risk (Figure 26). Sites rated as

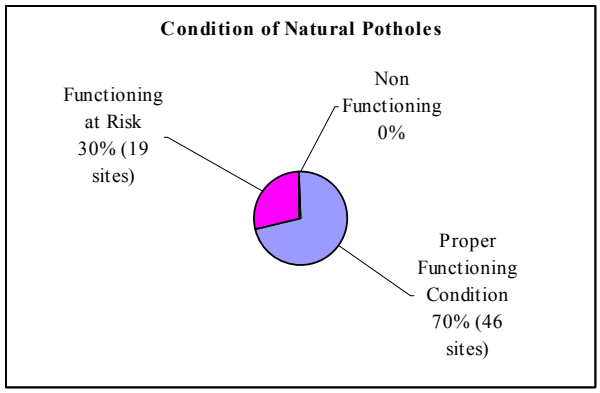

Figure 26. Condition of Natural Pothole Field Sites (assessed by NHP)

functioning at risk had one or more of the following disturbances: hydrological modification, road or gas pipeline encroachment or chisel plowing of adjacent uplands. Although accounting for only 30% of the sites, 44% of the wetland acres surveyed were in this category. Modifications include excavations and dams to increase stock water and improve waterfowl habitat. Site descriptions are included in Appendix C.

In some locations, it appeared that ditches had been filled in to restore natural hydrologic function. Restoration of original prairie pothole hydrologic function can be successful in restoring vegetative communities. Seabloom and van der Walk (2003) and Galatowitsch (1993) report that natural vegetation recolonized sites in Iowa where wetland hydrology has been restored. Recolonized communities in temporarily, seasonally and semipermanently flooded zones of potholes take longer to develop. In permanently flooded zones, communities were quickly restored. Restored wetlands had lower species richness and cover within the first few years of restoration but may, over longer periods of time, be able to recruit most or all of the original flora assuming that exotic species do not take over sites during this recovery period.

Reservoirs were assessed somewhat differently than natural potholes. The typical hydrological functioning of the reservoirs, i.e. water impounded in spring and early summer and later evaporated or used by livestock, was considered the proper functioning condition. Thus, these sites were not assessed based on what their hydrological function was before the reservoir was constructed. Only 43 of the 114 assessed reservoirs was rated as being in proper functioning condition (Figure 27).

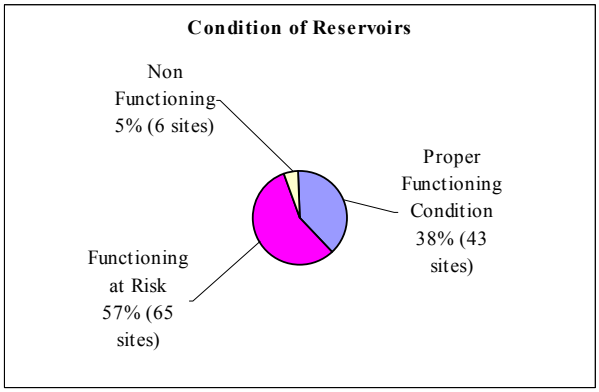

Figure 27. Condition of Reservoir Field Sites (assessed by BLM)

Many of the sites were rated as functioning at risk or not functioning because they had low plant species diversity or a high percentage of undesirable plants.

A comparison between the NWI mapping of hydrological modification and the actual field assessment is shown in Figure 28. The greatest misclassification occurred with sites where hydrological modification, primarily ditching or

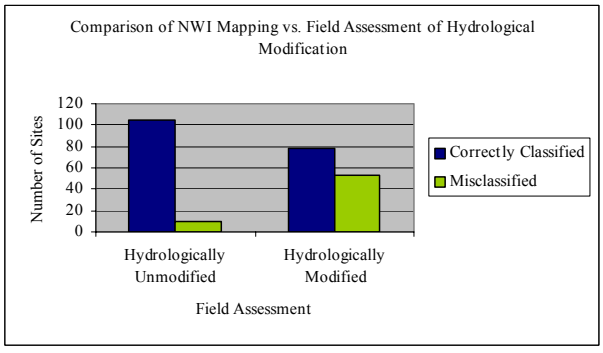

Figure 28. Comparison of NWI Classification of Hydrological Modification and Field Assessment

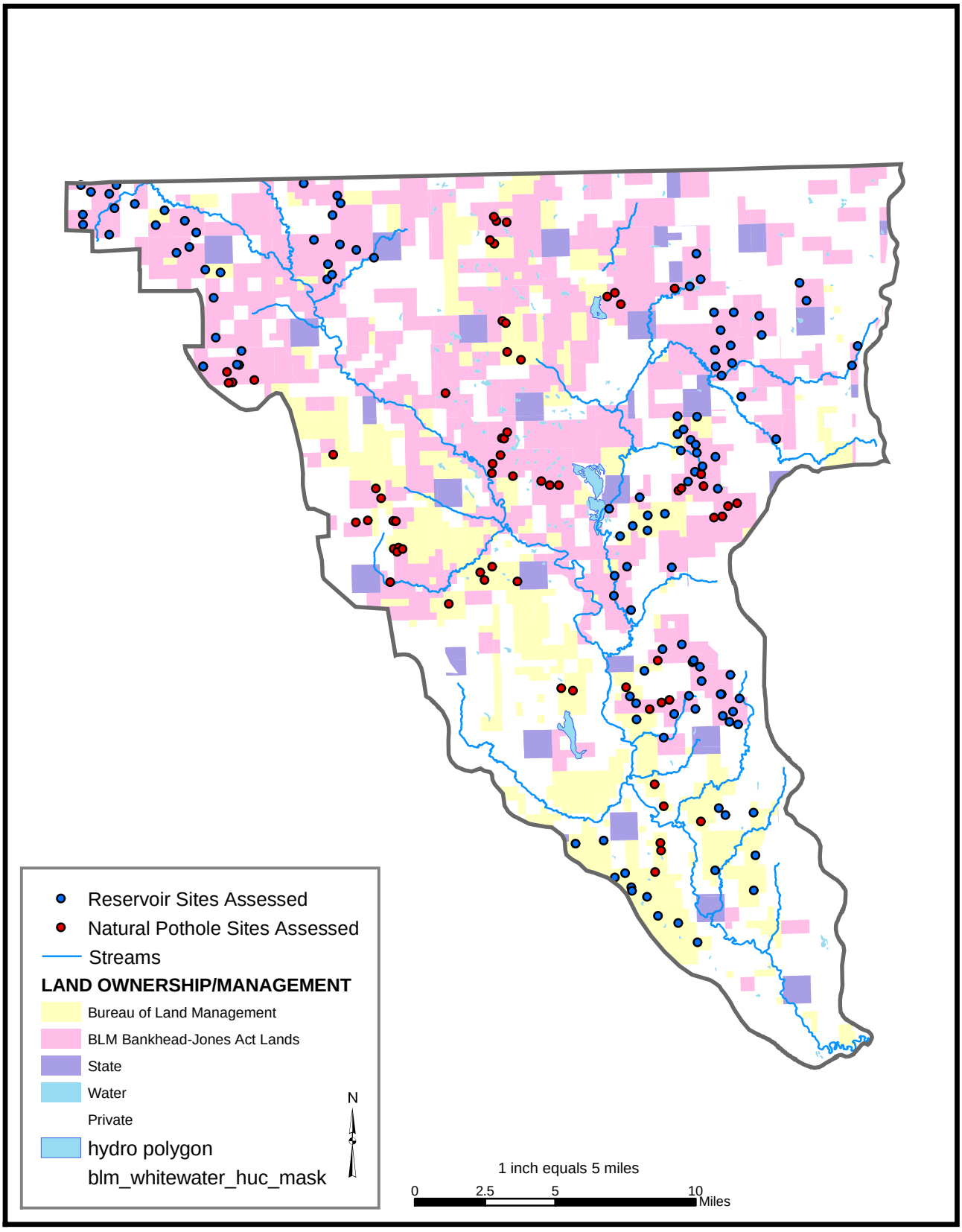

Figure 25. Location of Field Sampling Sites

road encroachment, is too inconspicuous to be seen in aerial photos.

Vegetation Communities

Pothole vegetation in the Whitewater watershed was strongly zoned like most prairie wetlands although one vegetation community type, Western wheatgrass-needleleaf sedge (Figure 29), was the most common and often the only community present at individual sites (see Table 3 for scientific names of native plant species used in this report).

This was due to both the small size and shallow depth of most potholes in the area and the geographic location at the very edge of the range of climatic suitability for pothole wetlands. If basins were deeper the wettest vegetation community type was Common spikerush and the intermediate community type was either Foxtail barley (Figure 30) or Western wheatgrass-foxtail barley. The Western wheatgrass-needle spikerush community type was always present, even if only a narrow ring around the edge of the pothole. Most of the pothole depressions in the Whitewater

Figure 29. Western wheatgrass - needle spikerush Community

Figure 30. Foxtail barley community

Table 3. Native plant species mentioned in the body of this report. A total list of species found in field assessments is in Appendix B. Table 7.

Common Name	Scientific Name	Family
Graminoids		
Blue grama	*Bouteloua gracilis*	Poaceae
Common spikerush	*Eleocharis palustris*	Cyperaceae
Common threesquare	*Schoenoplectus pungens*	Cyperaceae
Foxtail barley	*Hordeum jubatum*	Poaceae
Western wheatgrass	*Pascopyrum smithii*	Poaceae
Green needlegrass	*Nassella viridula*	Poaceae
Hardstem bulrush	*Schoenoplectus acutus*	Cyperaceae
Inland saltgrass	*Distichlis spicata*	Poaceae
Needle and thread	*Hesperostipa comata*	Poaceae
Needle spikerush	*Eleocharis acicularis*	Cyperaceae
Needleleaf sedge	*Carex duriuscula*	Cyperaceae
Nuttall's alkaligrass	*Puccinellia nuttalliana*	Poaceae
Softstem bulrush	*Schoenoplectus tabermontani*	Cyperaceae
Wheat sedge	*Carex atherodes*	Cyperaceae
Shrubs		
Big sage	*Artemisia tridentata*	Asteraceae
Saltbush	*Atriplex spp.*	Chenopodiaceae

watershed do not hold water long enough for evaporation to contribute greatly to residual salinity although some larger basins lower on the landscape did have noticeable salt deposits and salt-tolerant vegetation (Figure 31). Western wheatgrass-Inland saltgrass and Saltbush communities were commonly found there.

Figure 31. Salt-affected flats

Vegetation associations that typically occur in the temporarily flooded portions of potholes are: Western wheatgrass-needleleaf sedge, Western wheatgrass-needleleaf sedge(-needle spikerush) and Western wheatgrass-foxtail barley.

Vegetation associations that typically occur in the seasonally flooded portions of potholes are: Foxtail barley, Foxtail barley-common spikerush(-needleleaf spikerush), Common spikerush, Needleleaf spikerush, and Inland saltgrass-Nuttall's alkaligrass. Lesica (1993) described two similar communities in what he referred to as the drawdown zone of potholes on the Blackfeet Indian Reservation: the Common spikerush-foxtail barley and Inland saltgrass-alkaligrass.

Vegetation associations that occur in the semipermanently flooded portions of potholes are: Common spikerush, Wheat sedge, Foxtail barley and Common threesquare, Softstem bulrush, or Hardstem bulrush. Lesica (1993) described two similar communities in what he referred to as the marsh zone of potholes: Wheat sedge-common spikerush and Common spikerush-needle spikerush.

Upland vegetation surrounding the potholes were predominantly the Needle and thread-blue grama community type. Also sparsely present were the Big sage/blue grama; Western wheatgrass-blue grama; and Western wheatgrass-green needlegrass community types.

Vegetation associations that are currently described in the National Vegetation Classification System (NVCS) that most closely fit the associations found in the Whitewater watershed are: Wheat sedge, Western wheatgrass-spikerush spp., Western wheatgrass, Foxtail barley, Common spikerush, Inland saltgrass, Nuttall's alkaligrass, Hardstem bulrush, and Kentucky bluegrass (western wheatgrass). The dominant upland vegetation is best described by the Needle and thread-blue grama Alliance, a higher classification level in the NVCS. Western wheatgrass-blue grama is a minor upland component. Additionally, one association has been described by the Montana Natural Heritage Program (and proposed for the NVCS) and is found in some potholes: Western wheatgrass-(needleleaf sedge). Appendix C contains descriptions of these associations.

Although the current global ranking for the Western wheatgrass-spikerush spp. type is G1, this association is now known to be far less rare than it was thought to be when the association was described and the ranking assigned. Thus, we do not consider it to be a community of concern.

A generalized crosswalk between wetland habitats and vegetative communities is shown in Table 4.

Exotic Species

Where the sod has not been broken for cropping or homesteads, the vegetation in this watershed is remarkably free of weeds. Very few non-

Table 4. Habitat crosswalk of Stewart and Kantrud vs. Cowardin for potholes typically found in Whitewater Watershed

Stewart and Kantrud 1971	Cowardin et al. 1979	Vegetative Communities Corresponding to Habitat
Wetland low prairie	Palustrine, Emergent, Temporarily Flooded	Western wheatgrass-needle spikerush Western wheatgrass-needleleaf sedge(-needle spikerush) Western wheatgrass-foxtail barley
Wet meadow	Palustrine, Emergent, Temporarily Flooded to Seasonally Flooded	Foxtail barley Foxtail barley-creeping spikerush(-needle spikerush) Needle spikerush
Shallow marsh	Palustrine, Emergent, Seasonally Flooded	Creeping spikerush Inland saltgrass-Nuttall's alkaligrass
Deep marsh	Palustrine, Emergent, Semipermanently Flooded	Creeping spikerush Wheat sedge Common threesquare Softstem bulrush Hardstem bulrush
Natural drawdown	Seasonally Flooded	Foxtail barley

forested, lower elevation landscapes in the United States (except Alaska) are without tremendous acreages of noxious weeds and other introduced Eurasian species. Some exotic species were recorded in the field assessments of wetlands (see Table 5).

The reservoir sites had significantly higher exotic species occurrence and cover: 51.6% of sites surveyed contained exotic species with an average cover of 10.9% (ranging from 1-41%) (Figure 32). Of the natural pothole sites surveyed 32.3% contained exotic species with an average cover of 2.7% (ranging from 1-11%) (Figure 33).

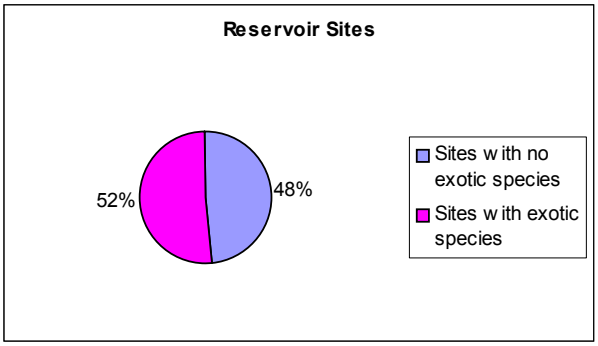

Figure 32. Percentage of reservoir sites in which exotic species were found

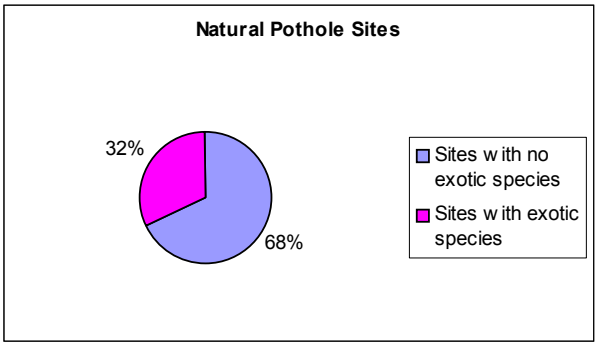

Figure 33. Percentage of natural pothole sites in which exotic species were found

The species shown in Table 6 with the greatest potential for invasion, expansion and competition with native species in potholes are: smooth brome, Kentucky bluegrass, fowl bluegrass, white sweetclover and yellow sweetclover. The three graminoid species are rhizomatous, adaptable and moderately to highly aggressive in taking over dominance of the vegetative community. They probably become established on overgrazed or otherwise disturbed sites. Smooth brome may well be the most aggressive of the three and is difficult to exterminate once established (Romo et al. 1990). Smooth brome and Kentucky bluegrass have replaced, for the most part, cover

Table 5. Exotic species found in pothole and reservoir assessments

Common Name	Scientific Name	Noxious Weed in Montana?
Graminoids		
Annual rabbitsfoot grass	*Polypogon monspeliensis*	No
Barnyardgrass	*Echinochloa crus-galli*	No
Canada bluegrass	*Poa compressa*	No
Crested wheatgrass	*Agropyron cristatum*	No
Fowl bluegrass	*Poa palustris*	No
Kentucky bluegrass	*Poa pratensis*	No
Smooth brome	*Bromus inermis*	No
Forbs		
Black bindweed	*Polygonum convolvulus*	No
Bull thistle	*Cirsium vulgare*	No
Canada thistle	*Cirsium arvense*	**Yes**
Common dandelion	*Taraxacum officinale*	No
Field cottonrose	*Logfia arvensis*	No
Lambsquarters	*Chenopodium album*	No
Mexican-fireweed	*Kochia scoparia*	No
Narrowleaf plantain	*Plantago lanceolata*	No
Russian thistle	*Salsola kali*	No
Saltlover	*Halogeton glomeratus*	No
Small tumbleweed mustard	*Sisymbrium loeselii*	No
White sweet clover	*Melilotus alba*	No
Yellow salsify	*Tragopogon dubius*	No
Yellow sweet clover	*Melilotus officinale*	No

by western wheatgrass. Fowl bluegrass has probably replaced foxtail barley or western wheatgrass on wetter microsites.

Dominance by these exotic graminoids degrades the ability of potholes to withstand wind events, wave flow events or overland flows, which are important components of two of the vegetation categories in the Lentic Standard Checklist (Pritchard et al. 1999). The minimum rooting depths of Kentucky bluegrass, fowl bluegrass and smooth brome are from 10-12", whereas the minimum rooting depth of western wheatgrass is 20". Western wheatgrass also has higher salinity, drought and anaerobic tolerances and can thus withstand the climate cycles and accompanying changes in pothole hydrology typical of the region. The sweetclovers have rapid growth rate, tall mature height (5') and are allelopathic. Thus, they can create a monoculture on a site, preventing native species from becoming established and/or expanding in cover. Their minimum rooting depths are 32", which probably makes them good soil stabilizers on coarser-textured soils, but plants are widely spaces and on fine-textured soils, much of the soil surface is left bare and erosion potential is high (USDA 2002).

Crested wheatgrass may also be of concern in the potholes with temporarily flooded hydrologic regimes. Crested wheatgrass is a strong competitor because it can take up phosphorus and soil moisture better than native species. Thus, it can invade and take over native herbaceous communities and forming monocultures, preventing native plant species from becoming re-established. These monocultures have low plant species diversity and high bare soil exposure (Lesica and DeLuca 1996, Heidinga and Wilson 2002). Many formerly tilled acres in the Whitewater watershed have been seeded to crested wheatgrass for erosion control. Drier pothole wetlands adjacent to these fallow fields may be invaded by crested wheatgrass, especially where soil surfaces have been disturbed by roads, vehicle traffic and overgrazing.

Table 6. Assessment of Wetlands by Grazing Allotment

Allotment Number	# of Pothole Sites Surveyed	# of Reservoir Sites Surveyed	Average Exotic Species Cover (Range) – in natural potholes	Average Exotic Species Cover (Range) – in reservoirs	Natural Pothole Sites Rated PFC (%)	Natural Pothole Sites Rated FAR (%)	Reservoir Sites Rated PFC (%)	Reservoir Sites Rated FAR (%)	Reservoir Sites Rated NF (%)
5009	0	6	---	0	---	---	20	80	0
5010	0	2	---	0	---	---	50	50	0
5011	0	4	---	4.7 (1-10)	---	---	50	50	0
5012	0	7	---	2.3 (1-3)	---	---	86	14	0
5014	5	0	1.0 (--)	---	60	40	---	---	---
5015	6	2	2.3 (1-3)	0	33.3	66.7	100		
5022	0	4	---	16.5 (3-30)	---	---	50	25	25
5033	0	2	---	3.0 (--)	---	---	50	50	0
5034	2	8	0	7.0 (3-10)	100	0	25	75	0
5035	5	0	6.0 (3-11)	---	100	0	---	---	---
5036	7	0	11.0 (--)	---	29	71	---	---	---
5037	9	0	1.5 (1-3)	---	78	22	---	---	---
5038	1	0	0	---	100	0	---	---	---
5041	2	4	3.0 (--)	0	100	0	---	---	
5042	3	5	0	11.0 (10-13)	100	0	50	50	0
5058	2	0	2.0 (--)	---	50	50	---	---	---
5059	1	0	3.0 (--)	---	100	0	---	---	---
5062	6	0	1.0 (--)	---	66.7	33.3	---	---	---
5065	2	9	1.0 (--)	25.4 (3-41)	100	0	22	67	11
5066	1	1	0	40 (--)	0	100	0	100	0
5069	3	0	1.0 (--)	---	100	0	---	---	---
5084	0	1	---	0	---	---	100	0	0
5085	3	1	1.0 (--)	0	100	0	0	100	0
5086	2	6	0	0	100	0	50	50	0
5087	0	4	---	6.5 (3-10)	---	---	0	100	0
5088	6	0	1.0 (--)	---	66.7	33.3	---	---	---
5089	0	7	---	0	---	---	0	100	0
5116	0	2	---	0	---	---	0	100	0
5172	0	2	---	0	---	---	---	---	---

Note: no survey assessments were done in the following allotments: 5013, 5016, 5021, 5028, 5030, 5031, 5032, 5039, 5063, 5064, 5067, 5080, 5081, 5090, 5170

Assessment by Grazing Allotments

Assessments by grazing allotments are shown in Table 6. Although some noticeable differences in wetland condition among allotments seem evident in the table, field observations of grazing impacts did not indicate substantial degradation of wetlands. Presumably the natural vegetation of the Whitewater Watershed is adapted to heavy grazing by large herbivores since it evolved with bison grazing for several thousand years. The most notable grazing impacts were seen around excavated or impounded reservoirs, where vegetation is often depauperate and livestock trails are numerous and well worn.

Species of Concern

One site of a Montana State species of concern, poison suckleya (*Suckleya suckleyana*) was found. The habitat, as can be seen in Figure 34, is a bare soil flat within an impoundment. The plant germinates after water has receded and/or evaporated during the growing season. Poison suckleya has an S1 ranking based on its rarity.

*Figure 34. Poison suckleya (*Suckleya suckleyana*)*

This is only the 4th reported occurrence of this plant in the state, although it may grow in other similar habitats in the prairie pothole region of Montana. We have searched the Heritage database and there are no other records of plant species of concern within the Whitewater watershed.

Animal species of concern that have been recorded in this watershed are: swift fox (*Vulpes velox*), Ferruginous Hawk (*Buteo regalis*) and Western hognose snake (*Heterodon nasicus*).

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Appendix A. Global/State Rank Definitions

Heritage Program Ranks

The international network of Natural Heritage Programs employs a standardized ranking system to denote global (range-wide) and state status (NatureServe 2002). Species are assigned numeric ranks ranging from 1 (critically imperiled) to 5 (demonstrably secure), reflecting the relative degree to which they are "at-risk". Rank definitions are given below. A number of factors are considered in assigning ranks — the number, size and distribution of known "occurrences" or populations, population trends (if known), habitat sensitivity, and threat. Factors in a species' life history that make it especially vulnerable are also considered (e.g., dependence on a specific pollinator).

Rank Definitions

G1 S1	Critically imperiled because of extreme rarity and/or other factors making it highly vulnerable to extinction.
G2 S2	Imperiled because of rarity and/or other factors making it vulnerable to extinction.
G3 S3	Vulnerable because of rarity or restricted range and/or other factors, even though it may be abundant at some of its locations.
G4 S4	Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
G5 S5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.
GU SU	Possibly imperiled, but status uncertain; more information needed.
GA SA	Native in nearby states, but in Montana believed to be accidentally introduced, deliberately planted, or escaped from plantings.
GH SH	Historical, known only from records over 50 year ago; may be rediscovered.
GX SX	Believed to be extinct; historical records only.

Combination Ranks

G#G# or S#S# Indicates a range of uncertainty about the rarity of the species.

Subranks

T#	Rank of a subspecies or variety; appended to the species' global rank of the full species, e.g. G4T3.

Qualifiers

Q	Taxonomic questions or problems exist, more information needed; appended to the global rank, e.g. G3Q.
?	Denotes uncertainty or for numeric ranks, inexactness.

Appendix B. Additional Reference Tables

Table 1. Wetland habitat classification levels from Classification of Natural Ponds and Lakes in the Glaciated Prairie Region *(Stewart and Kantrud 1971) most applicable to the prairie potholes in the Whitewater watershed*
*Because conductance can fluctuate greatly in a wetland, plant species occurrences are used as indicators of the salinity of the vegetation zone.

Taxon	**Definition**
Vegetation Zones	
Wetland low-prairie	surface water ordinarily maintained for only a brief period in the early spring
Wet meadow	surface water usually maintained for only a few weeks after the spring snowmelt and occasionally for several days after heavy rainstorms
Shallow-marsh emergent	surface water maintained for an extended period in spring and early summer but frequently gone during late summer and fall
Deep-marsh emergent	surface water maintained throughout the spring and summer and frequently maintained into fall and winter
Permanent open water	self-explanatory
Hydrologic Phases	
Normal emergent phase	plant growth extends above the water surface
Open water phase	no plants or plant growth beneath water surface
Natural drawdown emergent phase	plants germinate on bare soil after surface water recedes
*Salinity Subclasses**	
Fresh	<40-500 micromhos/cm3 conductance
Slightly brackish	500-2,000 micromhos/cm3 conductance
Moderately brackish	2,000-5,000 micromhos/cm3 conductance
Subsaline	5,000-15,000 micromhos/cm3 conductance

Table 2. Wetland habitat classification levels from the U.S. Fish and Wildlife Service's National Wetland Inventory system (Cowardin et al. 1979) that are most applicable to the prairie potholes in the Whitewater watershed

Taxon	**Definition**
Systems and Subsystems	
Palustrine (P)(System)	persistent emergents (herbaceous plants), trees, shrubs and/or emergent mosses cover more than 30% of the area
Lacustrine (L) (System)	inland water body; situated in a basin; catchment or on level or sloping ground; >8 acres in area; >2 ft. in depth and/or with wave-formed shoreline; water usually not flowing
Littoral (2) (Subsystem)	the wetland habitat of the Lacustrine system dominated by nonpersistent emergents (herbaceous plants rooted in the lakebed)
Riverine (R) (System)	inland water body; situated in a channel; water usually flowing
Intermittent (4) (Subsystem)	channel contains flowing water for only part of the year
Lower Perennial (2) (Subsystem)	channel contains water throughout the year; gradient is low and water velocity is slow
Classes within the above Systems and Subsystems	
Aquatic Bed (AB)	dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years
Emergent (EM)	dominated by erect, rooted herbaceous hydrophytes
Scrub-Shrub (SS)	dominated by woody vegetation less than 6m in height
Forested (FO)	dominated by woody vegetation greater than 6 m in height
Unconsolidated Bottom (UB)	at least 25% cover of particles smaller than stone; less than 30% vegetative cover
Unconsolidated Shore (US)	less than 25% cover of stones, boulders and/or bedrock; less than 30% vegetative cover
Streambed (SB)	exposed when intermittent stream is running no water
Water Regime Modifiers	
Intermittently Exposed (G)	surface water is present throughout the yar except in years of extreme drought
Semipermanently Flooded (F)	surface water persists throughout the growing season in most years; when surface water is absent, the water table is usually at or very near the land surface
Seasonally Flooded (C)	surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years; when the surface water is absent, the water table is often near the land surface
Temporarily Flooded (A)	surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season
Special Modifiers (denoting hydrological modification)	
Excavated (x)	wetland lies within a basin or channel excavated by humans
Impounded/Diked (h)	wetland created or modified by a barrier or dam that purposely or unintentionally obstructs the outflow of water; created by humans or beavers; wetland created or modified by a human-made barrier or dike designed to obstruct the inflow of water
Partly Drained/Ditched (d)	the water level has been artificially lowered

Table 3. Acreage of polygons in NWI wetland classes

NWI Class Code	NWI Class Description	Acres
L2ABGh	Lacustrine, Littoral, Aquatic Bed, Intermittently Exposed, Diked/Impounded	156.8
L2ABFTabl	Lacustrine, Littoral, Aquatic Bed, Semipermanently Flooded	623.0
L2ABFh	Lacustrine, Littoral, Aquatic Bed, Semipermanently Flooded, Diked/Impounded	17.9
L2UBG	Lacustrine, Littoral, Unconsolidated Bottom, Intermittently Exposed	23.6
L2USC	Lacustrine, Littoral, Unconsolidated Shore, Seasonally Flooded	518.9
L2USCh	Lacustrine, Littoral, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded	398.1
L2USAh	Lacustrine, Littoral, Unconsolidated Shore, Temporarily flooded, Diked/Impounded	7.5
	Total Lacustrine Acres	**1745.8**
	Total Diked/Impounded Lacustrine Acres	**580.3**
	Total Hydrologically Modified Lacustrine Acres	**580.3**
PABF	Palustrine, Aquatic Bed, Semipermanently Flooded	328.4
PABFh	Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded	724.0
PABFhx	Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded,	0.7
PABFx	Palustrine, Aquatic Bed, Semipermanently Flooded, Excavated	88.9
PEMF	Palustrine, Emergent, Semipermanently Flooded	74.4
PEMFx	Palustrine, Emergent, Semipermanently Flooded, Excavated	0.5
PEMC	Palustrine, Emergent, Seasonally Flooded	3697.0
PEMCh	Palustrine, Emergent, Seasonally Flooded, Diked/Impounded	83.3
PEMCx	Palustrine, Emergent, Seasonally Flooded, Excavated	0.2
PEMCd	Palustrine, Emergent, Seasonally Flooded, Partially Drained/Ditched	119.5
PEMA	Palustrine, Emergent, Temporarily flooded	8437.4
PEMAh	Palustrine, Emergent, Temporarily flooded, Diked/Impounded	74.1
PEMAd	Palustrine, Emergent, Temporarily flooded, Partially Drained/Ditched	48.3
PEM/USA	Palustrine, Emergent, Unconsolidated Shore, Temporarily flooded	2.5
PFOA	Palustrine, Forested, Temporarily flooded	0.4
PFOAx	Palustrine, Forested, Temporarily flooded, Excavated	0.3
PSSA	Palustrine, Scrub-Shrub, Temporarily flooded	4.2
PUBGx	Palustrine, Unconsolidated Bottom, Intermittently Exposed, Excavated	43.5
PUBFx	Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated	4.3
PUSC	Palustrine, Unconsolidated Shore, Seasonally Flooded	11.3
PUSCh	Palustrine, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded	1.5
PUSCx	Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated	0.5
PUSA	Palustrine, Unconsolidated Shore, Temporarily flooded	285.4
PUSAh	Palustrine, Unconsolidated Shore, Temporarily flooded, Diked/Impounded	0.7
	Total Palustrine Acres	**14031.3**
	Total Excavated/Partially Drained/Ditched Palustrine Acres	**306**
	Total Diked/Impounded Palustrine Acres	**883.6**
	Total Hydrologically Modified Palustrine Acres	**1190.3**
R4SBC	Riverine, Intermittent, Streambed, Seasonally Flooded	63.5
R4SBF	Riverine, Intermittent, Streambed, Semipermanently Flooded	80.1
R4SBA	Riverine, Intermittent, Streambed, Temporarily flooded	11.4
R2UBG	Riverine, Lower Perennial, Unconsolidated Bottom, Intermittently Exposed	2.7
	Total Riverine Acres	**157.7**
	Total Hydrologically Modified Riverine Acres	**0**

Table 4. Hydrologic Modification of NWI polygons in Whitewater Watershed

NWI Class Code	NWI Class Description	% Hydrologic Modified
L2ABG	Lacustrine, Littoral, Aquatic Bed, Intermittently Exposed	100.0%
L2USC	Lacustrine, Littoral, Unconsolidated Shore, Seasonally Flooded	43.4%
L2ABF	Lacustrine, Littoral, Aquatic Bed, Semipermanently Flooded	2.7%
L2UBG	Lacustrine, Littoral, Unconsolidated Bottom, Intermittently Exposed	0.0%
L2USA	Lacustrine, Littoral, Unconsolidated Shore, Temporarily Flooded	100.0%
	All Lacustrine Classes	**33.2%**
PABF	Palustrine, Aquatic Bed, Semipermanently Flooded	28.8%
PEMF	Palustrine, Emergent, Semipermanently Flooded	0.7%
PEMC	Palustrine, Emergent, Seasonally Flooded	5.2%
PEMA	Palustrine, Emergent, Temporarily Flooded	1.4%
PEM/USA	Palustrine, Emergent, Unconsolidated Shore, Temporarily flooded	0.0%
PFOA	Palustrine, Forested, Temporarily flooded	43.0%
PSSA	Palustrine, Scrub-Shrub, Temporarily flooded	0.0%
PUBG	Palustrine, Unconsolidated Bottom, Intermittently Exposed, Excavated	100%
PUBF	Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated	100%
PUSC	Palustrine, Unconsolidated Shore, Seasonally Flooded	0.0%
PUSA	Palustrine, Unconsolidated Shore, Temporarily flooded	<0.1%
	All Palustrine Classes	**8.5%**
R4SBC	Riverine, Intermittent, Streambed, Seasonally Flooded	0.0%
R4SBF	Riverine, Intermittent, Streambed, Semipermanently Flooded	0.0%
R4SBA	Riverine, Intermittent, Streambed, Temporarily flooded	0.0%
R2UBG	Riverine, Lower Perennial, Unconsolidated Bottom, Intermittently Exposed	0.0%
	All Riverine Classes	**0.0%**

Table 5. Landcover within buffers adjacent to perennial and intermittent streams (in USGS 1:100,000 digitized streams layer)

General Landcover Category	Specific Land Cover Category	Coverage within 50m buffer (acres)	% of Total Land Area within 50m buffer	Coverage within 100m buffer (acres)	% of Total Land Area within 100m buffer	Coverage within 150m buffer (acres)	% of Total Land Area within 150m buffer
Barren	Bare Rock/Sand/Clay	0.9	<0.1	0.9	1.0	0.9	0.7
Forested Upland	Evergreen Forest	114.0	1.0	145.9	10.4	165.1	8.5
	Deciduous Forest	80.9	13.3	127.9	73.2	161.3	75.1
Herbaceous Upland	Shrubland	1039.9	69.8	1579.6	0.4	1892.3	0.4
Shrubland	Grasslands/Herbaceous	5448.8	0.5	11117.5	4.5	16639.2	3.9
Water	Woody Wetlands	35.6	5.0	67.3	<0.1	95.8	<0.1
Wetlands	Emergent Herbaceous Wetlands	393.2	<0.1	678.1	5.5	871.0	6.2
Total Acres of Natural Open Land		**7163.3**	**91%**	**13817.2**	**90%**	**19975.6**	**90%**
Barren	Quarries/Strip Mines/Gravel Pits	1.9	<0.1	7.5	0.8	14.5	0.7
Developed	Low Intensity Residential	1.3	<0.1	3.1	<0.1	3.2	0.1
	Commercial/Industrial/Transportation	1.9	<0.1	5.0	1.0	8.1	0.7
Herbaceous Planted/Cultivated	Pasture/Hay	1.5	4.6	2.1	<0.1	3.0	<0.1
	Fallow	358.1	<0.1	828.6	4.1	1379.3	4.2
	Row Crops	1.1	4.2	3.1	<0.1	5.2	<0.1
	Small Grains	325.1	<0.1	619.3	<0.1	921.3	<0.1
Total Acres in Buffers		**7854.2**	**100%**	**15285.9**	**100%**	**22310.2**	**100%**

Table 6. Landcover within buffers surrounding wetland polygons (in NWI digitized wetland polygon map)

General Category	Specific Landcover	Acreage within 50m Buffers	% of Total Land Area within 50m buffer	Acreage within 100m Buffers	% of Total Land Area within 100m buffer	Acreage within 150m Buffers	% of Total Land Area within 150m buffer
Barren	Bare Rock/Sand/Clay	0.6	<0.1	0.6	<0.01	1.0	<0.01
Forested Upland	Deciduous Forest	108.4	0.3	185.1	0.2	234.8	0.2
	Evergreen Forest	185.5	0.4	226.5	0.3	261.9	0.2
Herbaceous Upland	Grasslands/Herbaceous	34253.7	82.6	73378.3	82.5	105619.7	81.3
Shrubland	Shrubland	1103.9	2.7	1704.5	1.9	2229.5	1.7
Water	Open Water	89.7	0.2	101.2	0.1	105.0	0.1
Wetlands	Emergent Herbaceous Wetlands	493.0	1.2	651.6	0.7	731.0	0.6
	Woody Wetlands	131.6	0.3	155.1	0.2	160.8	0.1
Total Acreage of Natural Open Land		**36416.4**	**87.8**	**76502.9**	**86.0**	**109493.7**	**84.3**
Barren	Quarries/Strip Mines/Gravel Pits	52.9	0.1	93.2	0.1	112.3	0.1
Developed	Commercial/Industrial/Transportation	16.0	<0.1	32.6	<0.01	46.6	<0.01
	Low Intensity Residential	0.6	0.0	3.7	<0.01	7.1	<0.01
Herbaceous Planted/Cultivated	Fallow	2826.3	6.8	7288.8	8.2	12109.2	9.3
	Pasture/Hay	52.2	0.1	128.2	0.1	206.8	0.2
	Row Crops	8.3	<0.1	14.5	<0.01	22.3	<0.01
	Small Grains	2085.6	5.0	4855.9	5.5	7876.4	6.1
Total Acreage in Buffers		**41458.3**	**100**	**88919.8**	**100.0**	**129874.4**	**100**

Table 7. Species list for all plants encountered in natural pothole and reservoir assessments

Scientific Name	Common Name
Agropyron cristatum	Crested wheatgrass
Agrostis scabra	Rough bentgrass
Alopecurus aequalis	Shortawn foxtail
Alopecurus carolinianus	Carolina foxtail
Beckmannia syzigachne	American sloughgrass
Bouteloua gracilis	Blue grama
Bromus inermis	Smooth brome
Carex atherodes	Wheat sedge
Carex diandra	Lesser-panicled sedge
Carex duriuscula	Needleleaf sedge
Carex simulata	Shortbeaked sedge
Deschampsia cespitosa	Tufted hairgrass
Distichlis spicata	Inland saltgrass
Echinochloa crus-galli	Barnyardgrass
Eleocharis acicularis	Needle spikerush
Eleocharis palustris	Common spikerush
Hordeum jubatum	Foxtail barley
Koeleria macrantha	Prairie junegrass
Muhlenbergia filiformis	Slender muhly
Panicum virgatum	Switchgrass
Pascopyrum smithii	Western wheatgrass
Poa compressa	Canada bluegrass
Poa palustris	Fowl bluegrass
Poa pratensis	Kentucky bluegrass
Poa secunda	Sandberg's bluegrass
Polypogon monspeliensis	Annual rabbitsfoot grass
Puccinellia nuttalliana	Nuttall's alkaligrass
Schoenoplectus acutus	Hardstem bulrush
Schoenoplectus pungens	Softstem bulrush
Schoenoplectus tabemontani	Threesquare bulrush
Spartina pectinata	Prairie cordgrass
Achillea millefolium	Common yarrow
Alisma gramineum	Narrowleaf water plantain
Alisma plantago-aquatica	American water plantain
Amaranthus albus	Tumbleweed
Antennaria microphylla	Rosy pussytoes
Antennaria spp.	Pussytoes
Arnica fulgens	Orange arnica
Artemisia ludoviciana	Prairie sagewort
Astragalus crassicarpus	Ground plum
Atriplex rosea	Red orache
Boisduvalia glabella	Smooth spike-primrose
Brassica spp.	Mustard
Callitriche hermaphroditica	Autumnal water-starwort
Cerastium spp.	Mouse-ear chickweed
Chenopodium album	Lambsquarter
Chenopodium leptophyllum	Slimleaf goosefoot
Chenopodium spp.	Goosefoot
Cirsium arvense	Canada thistle
Cirsium undulatum	Wavyleaf thistle
Cirsium vulgare	Bull thistle

Collomia linearis	Narrow-leaf collomia
Conyza canadensis	Horseweed
Descurainia incana	Mountain tansymustard
Descurainia spp.	Tansymustard
Elodea canadensis	Canada waterweed
Epilobium paniculatum	Tall annual willowherb
Glycyrrhiza lepidota	American licorice
Grindelia squarrosa	Curlycup gumweed
Gutierrezia sarothrae	Broom snakeweed
Halogeton glomeratus	Saltlover
Hedeoma hispida	Rough pennyroyal
Helianthus annuus	Common sunflower
Heliotropium curassavicum	Salt heliotrope
Iva axillaris	Poverty-weed
Kochia scoparia	Mexican-fireweed
Lactuca serriola	Prickly lettuce
Logfia arvensis	Field cottonrose
Melilotus alba	White sweetclover
Melilotus officinale	Yellow sweetclover
Mentha arvensis	Field mint
Myriophyllum spp.	Watermilfoil
Navarretia intertexta	Needle-leaf navarettia
Opuntia polyacantha	Plains prickly pear
Plantago aristata	Large-bracted plantain
Plantago lanceolata	Narrowleaf plantain
Plantago major	Common plantain
Plantago patagonica	Indian-wheat
Polygonum amphibium	Water smartweed
Polygonum convolvulus	Ivy bindweed
Polygonum douglasii	Johnston's knotweed
Potamogeton foliosus	Leafy pondweed
Potamogeton richardsonii	Richardson's pondweed
Potentilla diversifolia	Diverse-leaved cinquefoil
Potentilla gracilis	Slender cinquefoil
Potentilla norvegica	Norwegian cinquefoil
Potentilla rivalis	Brook cinquefoil
Ratibida columnifera	Prairie coneflower
Rumex crispus	Curly dock
Rumex salicifolius	Willow dock
Sagittaria cuneata	Arumleaf arrowhead
Salicornia rubra	Red glasswort
Salsola kali	Russian thistle
Sisymbrium loeselii	Small tumblemustard weed
Suaeda depressa	Pursh seepweed
Taraxacum officinale	Common dandelion
Tragopogon dubius	Yellow salsify
Trifolium spp.	Clover
Typha latifolia	Common cattail
Verbena bracteata	Bracted verbena
Veronica peregrina	Purslane speedwell
Xanthium strumarium	Common cocklebur
Salix exigua	Coyote willow

Appendix C. Plant Association Descriptions

Carex atherodes Herbaceous Vegetation

Awned Sedge Herbaceous Vegetation
Global Rank: G3G5 State Rank: S3S5
Element Code: CEGL002220

Element Concept

Summary: This awned sedge wet meadow occurs in the northern tallgrass prairie region of the United States and Canada. Stands occur on lowland sites that have standing water for several weeks each year. These sites are typically in depressions or basins but can be along streams and rivers. The water may be fresh or moderately saline. Soils can be mineral but mucks often form through the buildup of organic material. Vegetation cover is usually high but can vary in wet or dry years. Dominant species are herbaceous and typically between 0.5 and 1 m tall. Forb diversity is moderate to high. *Carex atherodes* may form essentially monotypic stands or just be the dominant species. Common associated species include *Alisma triviale, Symphyotrichum lanceolatum (= Aster lanceolatus), Eleocharis palustris, Glyceria grandis* (in drier stands), *Mentha arvensis, Phalaris arundinacea, Polygonum amphibium, Scolochloa festucacea, Sium suave*, and *Sparganium eurycarpum*. Shrubs, including *Salix* spp., can invade this community, especially in the eastern portions of its range.

Comments: See Dix and Smeins (1967) for a discussion of the hydrology of this type, which borders on temporarily vs. seasonally flooded. See also Stewart and Kantrud (1972, including photos on pp. 34-35). Brotherson (1969) performed an ordination of pothole and drainage communities on a prairie in northwestern Iowa and found a community with 55% cover by *Carex atherodes*. The only other species with more than 4% cover was *Polygonum amphibium*, at 30%. *Schoenoplectus fluviatilis (= Scirpus fluviatilis), Calamagrostis canadensis, Carex lasiocarpa, Spartina pectinata*, and *Carex aquatilis* all had between 1 and 3% cover. This community occurred as a narrow band around potholes or sometimes in wide patches.
The relationship of this community and *Scolochloa festucacea* Herbaceous Vegetation needs to better defined. *Carex atherodes* tends to be on non-saline sites while *Scolochloa festucacea* tends to do better on mildly to moderately saline sites (Walker and Coupland 1970). However, the two can co-occur or codominate on mildly saline sites. *Carex atherodes* tends to occur on drier sites (Smith 1973).

Element Distribution

Range: This awned sedge wet meadow occurs in the northern tallgrass prairie region of the United States and Canada, from Minnesota and Iowa, north and west into the Dakotas, Manitoba and perhaps other provinces.

States/Provinces: IA:S?, MB:S2, MN:S?, ND:S?, SD:S?

Element Sources

References: Brotherson 1969, Dix and Smeins 1967, Looman 1982, MNNHP 1993, Smith 1973, Stewart and Kantrud 1971, Stewart and Kantrud 1972, Walker and Coupland 1970

Authors: J. Drake, mod. D. Faber-Langendoen, The Nature Conservancy, Midwestern Conservation Science, Minneapolis, MN

Confidence: 2

***Distichlis spicata* Herbaceous Vegetation**
Inland Saltgrass Herbaceous Vegetation
Global Rank: G5 State Rank: S4
Element Code: CEGL001770

Element Concept

Summary: These grasslands occur in semi-arid and arid western North America from southern Saskatchewan to Mexico. Stands are found in lowland habitats such as playas, swales and terraces along washes that are typically intermittently flooded. The flooding is usually the result of highly localized thunderstorms which can flood one basin and leave the next dry. However, this association may also occur in other flood regimes (temporarily, seasonally, and semipermanently). Soil texture ranges from clay loam to sandy clay. These soils are often deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations. Salinity is likely more important than flooding as an environmental factor. Vegetation cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Minor cover of associated graminoids may include *Muhlenbergia asperifolia, Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia, Eleocharis palustris, Puccinellia nuttalliana*, and *Juncus balticus*. Associated forbs, such as *Iva axillaris, Helianthus* spp., Asteraceae spp. (from lower salinity sites), *Salicornia rubra, Triglochin maritima*, and *Suaeda* spp., may also be present. Shrubs are rare, but scattered *Atriplex canescens* and *Sarcobatus vermiculatus* may be present.

Comments: This graminoid association is characteristically dominated by *Distichlis spicata*. Closely related communities include *Pascopyrum smithii - Distichlis spicata* Herbaceous Vegetation (CEGL001580), *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation (CEGL001687), and several others.

Element Distribution

Range: This grassland association occurs in low areas in semi-arid and arid western North America from southern Saskatchewan to Mexico.

States/Provinces: AZ:S3, CA:S3, CO:S3, ID:S4, MT:S4, NM:S4, NV:S?, OR:S4, SK:S?, UT:S3S5, WA:S1?, WY:S3

Element Sources

References: Baker 1984a, Beatley 1976, Bourgeron and Engelking 1994, Brotherson 1987, Bunin 1985, Costello 1944b, Crouch 1961a, Daniels 1911, Daubenmire 1970, Dodd and Coupland 1966, Driscoll et al. 1984, Franklin and Dyrness 1973, Graham 1937, Hansen et al. 1991, Hansen et al. 1995, Hyder et al. 1966, Johnston 1987, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Klipple and Costello 1960, Muldavin et al. 2000a, Osborn 1974, Ralston 1969, Ramaley 1942, Rogers 1953, Sawyer and Keeler-Wolf 1995, Shanks 1977, Shupe et al. 1986, Soil Conservation Service 1978, Stearns-Roger Inc. 1978, Tuhy and Jensen 1982, Ungar 1967, Ungar 1968, Ungar 1970, Ungar et al. 1969, Vestal 1914, Weaver and Albertson 1956

Authors: K.A. Schulz, THE NATURE CONSERVANCY, WESTERN CONSERVATION SCIENCE, BOULDER, CO

Confidence: 2

Eleocharis palustris Herbaceous Vegetation

Marsh Spikerush Herbaceous Vegetation
Global Rank: G5 State Rank: S5
Element Code: CEGL001833

Element Concept

Summary: This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States. Stands occur in small depressions in intermittent streambeds or depression ponds that flood early in the season and may dry out by summer. Stands are composed of submersed and emergent rooted vegetation under 1 m tall that is dominated by *Eleocharis palustris*, often in nearly pure stands. Soils are generally fine-textured.

Element Distribution

Range: This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States.

States/Provinces: BC:S4, CA?, CO:S4, ID:S3, MT:S5, NE:S?, NV:SR, OR:S5, SD:S?, SK:S?, UT:S3?, WA:S3?, WY:S3

Element Sources

References: Baker 1983c, Baker and Kennedy 1985, Billings 1945, Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bunin 1985, Driscoll et al. 1984, Ellis et al. 1979, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988a, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Kovalchik 1987, Kovalchik 1993, Mutel 1973, Mutel and Marr 1973, Padgett et al. 1988b, Padgett et al. 1989, Penfound 1953, Ramaley 1919a, Ramaley 1942, Stearns-Roger Inc. 1978, Steinauer and Rolfsmeier 2000, Stewart 1940, Von Loh 2000, Youngblood et al. 1985a

Authors: D. Faber-Langendoen, mod. K. Schulz, mod. M.S. Reid, THE NATURE CONSERVANCY, WESTERN CONSERVATION SCIENCE, BOULDER, CO

Confidence: 1

Hesperostipa comata-Bouteloua gracilis Herbaceous Alliance

Needle-and-Thread - Blue Grama Herbaceous Alliance

Alliance Code: 1234

Alliance Concept

Summary: This alliance is widespread across upland sites in the northern Great Plains. Its communities tend to be the climax communities on fertile dry-mesic sites across much of its range. It is dominated by mid and short grass species; woody species do not regularly achieve prominence. Few of the species exceed 1 m while many, including *Bouteloua gracilis*, do not exceed 50 cm. The most abundant species are *Hesperostipa comata (= Stipa comata)* and *Bouteloua gracilis*. On more mesic sites *Hesperostipa comata* is predominant, while on areas that are drier or subject to light grazing *Bouteloua gracilis* takes precedence. Other graminoid species that are commonly found in communities of this alliance are *Aristida purpurea var. longiseta (= Aristida longiseta), Carex duriuscula (= Carex eleocharis), Carex filifolia, Koeleria macrantha, Nassella viridula*, and *Pascopyrum smithii*. Sites in the southern half of the range of this alliance may have significant amounts of *Bouteloua curtipendula*. Forbs are common but not usually abundant. Forb species that are regularly found are *Artemisia frigida, Gaura coccinea, Gutierrezia sarothrae (= Gutierrezia diversifolia), Liatris punctata, Sphaeralcea coccinea (= Malvastrum coccineum), Phlox hoodii*, and *Sphaeralcea coccinea*. The clubmoss *Selaginella densa* is present in many stands in this alliance. Scattered shrubs are sometimes present. These include *Prunus virginiana, Rhus aromatica*, and *Symphoricarpos occidentalis*. In the western and southwestern portions of its range, *Cercocarpus montanus* may be found where this alliance occurs on slopes.

Communities in this alliance are found on flat to moderately steep topography. The soils are sandy loam, loam, or sometimes clay loam. They are often well-developed and derived from either glacial deposits or sometimes limestone or sandstone (Hanson and Whitman 1938, Coupland 1950, Hanson 1955).

Comments: Communities in this alliance can be confused with communities of the *Bouteloua gracilis* Herbaceous Alliance (A.1282), especially in Wyoming. More classification work is needed to clarify the concept boundaries between stands in this alliances.

Alliance Distribution

Range: This alliance is found in the western Great Plains, from western Kansas to North Dakota, west into Colorado, Wyoming and Montana. The alliance also extends north into Canada in Saskatchewan, Manitoba, and probably Alberta.

States/Provinces: AB CO KS MB MT ND NE SD SK WY

Federal Lands: NPS (Badlands?, Fort Laramie, Scotts Bluff, Theodore Roosevelt, Wind Cave); USFWS (Lacreek)

Alliance Source

References: Aldous and Shantz 1924, Badaracco 1971, Bear Creek Uranium Mine Application n.d., Clements and Goldsmith 1924, Comer et al. 1999, Cooper et al. 1995, Cotter-Ferguson Project n.d., Coupland 1950, Coupland 1992a, Davis 1959, DeVelice et al. 1995, FEIS 1998, Faber-Langendoen et al. 1996, Hansen 1985, Hansen and Hoffman 1988, Hansen et al. 1984, Hanson 1955, Hanson 1957, Hanson and Dahl 1956, Hanson and Whitman 1938, Hardy Ranch Mine Application n.d., Hess 1981, Hubbard 1950, Johnston 1987, Kuchler 1964, Laurenroth et al. 1994, Livingston 1947, Moir 1969b, Mueggler and Stewart 1980, Ramaley 1916b, Smoliak 1965, Smoliak et al. 1972, Soil Conservation Service 1978, Stearns-Roger Inc. 1978, Stoecker-Keammerer Consultants n.d.(a), Tolstead 1941, Tolstead 1942, Trammell and Trammell 1977, Vestal 1914, Weaver and Albertson 1956

Authors: The Nature Conservancy, Midwestern Conservation Science, Minneapolis, MN; Mod. M.S. REID

Hordeum jubatum Herbaceous Vegetation

Foxtail Barley Herbaceous Vegetation
Global Rank: G4 State Rank: S4
Element Code: CEGL001798

Element Concept

Summary: This foxtail barley community type is found in the northern and central Great Plains of the United States and Canada, Utah and may occur elsewhere in the interior western U.S. Stands are found in lowlands with moderately to strongly saline soils. The topography is flat and the soils are often flooded or saturated in the spring. The vegetation is dominated by short and medium tall graminoids with a total vegetation cover of nearly 100%. Shrubs are usually absent. *Hordeum jubatum* dominates the community. Other common species in this community are *Elymus trachycaulus, Distichlis spicata, Pascopyrum smithii, Poa arida, Poa compressa*, and *Rumex crispus*.

Comments: This type is poorly defined. This abstract is based on two descriptions of *Hordeum jubatum*-dominated stands which are assumed to be examples of this community. These stands may be variants of *Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis* Herbaceous Vegetation (CEGL002273) and *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582). The relationship between *Hordeum jubatum* Herbaceous Vegetation (CEGL001798) and these types is unclear. Both communities usually contain *Hordeum jubatum* and *Distichlis spicata* or *Pascopyrum smithii* in varying amounts. The presence of *Puccinellia nuttalliana* or *Suaeda calceoliformis* may be distinguishing factors. They appear to be more characteristic of strongly saline areas while *Hordeum jubatum* can dominate on less saline sites (Redmann 1972). Classification problems may arise on intermediate sites when *Hordeum jubatum* is the dominant species and *Distichlis spicata, Pascopyrum smithii, Puccinellia nuttalliana*, and *Suaeda calceoliformis* are present in more than minor amounts.

Element Distribution

Range: This foxtail barley community type is found in the northern and central Great Plains of the United States and Canada, ranging from Colorado to Saskatchewan. It is also described from Utah and may occur elsewhere in the interior West.

States/Provinces: CO:S3?, MT:S4, ND:S?, SD?, SK:S?, UT:S?

Element Sources

References: Baker 1984a, Barnes and Tieszen 1978, Bourgeron and Engelking 1994, Bunin 1985, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Redmann 1972, Reid 1974, Ungar 1967, Vestal 1914, Von Loh 2000

Authors: J. Drake, mod. K. Schulz, THE NATURE CONSERVANCY, WESTERN CONSERVATION SCIENCE, BOULDER, CO

Confidence: 3

***Pascopyrum smithii* Herbaceous Vegetation**
Western Wheatgrass Herbaceous Vegetation
Global Rank: G3G5Q State Rank: S4
Element Code: CEGL001577

Element Concept

Summary: This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, and the interior western United States and possibly Canada. Stands occur on level to gently sloping terrain. They are found on alluvial fans, swales, river terraces, floodplains, valley floors and basins. The soils are clay, clay loam, and silt loam. *Pascopyrum smithii* strongly dominates the moderate to dense (40-100% cover) mixedgrass herbaceous canopy that grows 0.5-1 m tall. Other graminoids that co-occur and may achieve local dominance are *Koeleria macrantha, Eleocharis palustris*, and *Poa* spp. Many other species common in midgrass prairies are also found in this community. These include *Artemisia ludoviciana, Eriogonum* spp., *Bouteloua gracilis, Nassella viridula*, and *Hesperostipa comata (= Stipa comata)*. Shrubs and dwarf-shrubs are rare in this community, but occasional woody plants such as *Artemisia tridentata, Symphoricarpos* spp., *Ericameria nauseosa*, or *Krascheninnikovia lanata* may be present. Introduced species, such as *Bromus tectorum, Bromus inermis, Poa pratensis, Melilotus* spp. or *Cirsium arvense*, are common in some stands, especially where disturbed.

Comments: This community is similar to several others that are dominated or codominated by *Pascopyrum smithii*. As currently defined, it represents a western Great Plains and foothills version of the western wheatgrass types in the central Great Plains. Further work needs to be done to refine the differences in composition and environmental characteristics. See recent descriptions by Thilenius et al. (1995) (*Pascopyrum smithii* sodgrass steppe, a more playa-like wheatgrass type) and by Steinauer and Rolfsmeier (2000). In Nebraska, Steinauer and Rolfsmeier (2000) suggest that their stands may resemble *Pascopyrum smithii - Nassella viridula* Herbaceous Vegetation (CEGL001583).

Element Distribution

Range: This midgrass prairie type is found in the northern and western Great Plains, Rocky Mountains, intermountain western United States and possibly Canada, ranging from North Dakota and possibly Saskatchewan, south to Nebraska and Colorado, west to northern Arizona, Utah and Idaho.

States/Provinces: AZ:S?, CO:S1?, ID:S1Q, MT:S4, NE:S?, SD:S?, SK:S?, UT:S3S5, WY:S4Q

Federal Lands: NPS (Fort Laramie, Scotts Bluff, Sunset Crater); USFWS (Ouray)

Element Source

References: Aldous and Shantz 1924, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Bunin 1985, Christensen and Welsh 1963, Driscoll et al. 1984, Godfread 1994, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Marr and Buckner 1974, Ramaley 1916b, Ramaley 1919b, Ramaley 1942, Shanks 1977, Soil Conservation Service 1978, Steinauer and Rolfsmeier 2000, Thilenius et al. 1995, Thomas et al. 2003c, Von Loh 2000

Authors: J. Drake, mod. K.A. Schulz, The Nature Conservancy, Western Conservation Science, Boulder, CO

Confidence: 3

Identifier: CEGL001577

***Pascopyrum smithii - Boutelous gracilis* Northern Plains Herbaceous Vegetation**
Western Wheatgrass - Blue Grama Northern Plains Herbaceous Vegetation
Global Rank: G? State Rank: S5?
Element Code: CEGL0015578

Element Concept

Summary: The western wheatgrass - blue grama Herbaceous Vegetation is provisionally identified as a northern Great Plains plant association of hot alluvial settings and thin soil settings overlying shale that are saturated in spring but dry for most of the growing season. It was also found at toeslope and footslope positions that presumably dry quickly following a saturated spring condition. It corresponds with the *Bouteloua-Agropyron* Faciation of Coupland (1960). Western wheatgrass comprises at least 20% cover and blue grama cover can be as much as twice that of western wheatgrass cover. Species diversity is low, and the characteristic forbs include *Opuntia polyacantha* (plains pricklypear), *Linum rigidum* (yellow flax), *Hedeoma hispida* (pennyroyal) and *Sphaeralcea coccinea* (scarlet globemallow). The subshrubs *Gutierrezia sarothrae* (broom snakeweed) and *Artemisia frigida* (fringed sage) are consistently present with low cover (<5%) and a somewhat depauperate form of *Artemisia cana* (silver sagebrush) is also occurs scattered at low densities.

This association was noted to be common in northern Valley County in valleybottom settings of Buggy, South Fork Rock Creek, Crow Creek; presumably it is comparably distributed in drainages of other study area creeks. Heidel et al. (2000), first documented this association for Sheridan County; examples were documented in valleybottom settings along the Big Muddy Creek and in small areas of Sand Creek. It was also found to be locally common on the rolling uplands above alkali lakes. Though the latter is an upland setting, the soils are Ustifluvents.

Classification comments: There is also a *Pascopyrum smithii - Bouteloua gracilis* plant association recognized from foothill and lower-montane valleys of southwestern states. The northern Great Plains examples are treated separately because of non-overlapping climate and setting. However, intervening examples and additional vegetation comparison may link these plant associations that are provisionally treated as distinct. The *Pascopyrum smithii - Bouteloua gracilis* Northern Plains Herbaceous Vegetation plant association grades into the *Pascopyrum smithii - Distichlis spicata* plant association with an increase in salinity (and flooding). It grades into the *Pascopyrum smithii* or *Pascopyrum smithii* - (*Carex duriuscula*) plant associations on sites experiencing intermittent flooding or that are subirrigated early in the growing season . This plant association is typical of the clayey range site. Additional vegetation sampling is needed to document and describe it.

Element Sources

Author(s): Cooper, S. V., C. Jean & B. Heidel, MTNHP

Confidence: 3

References: Cooper et al. 2001

***Pascopyrum smithii - (Carex duriuscula)* Herbaceous Vegetation**
Western Wheatgrass - (Needleleaf Sedge) Herbaceous Vegetation
Global Rank: G? State Rank: S?
Element Code: CEGLMTHP61

Element Concept

Summary: This small patch association was sampled and observed numerous times within a two county area in north-central Montana. This community is associated with shallow depressions that in "normal" years probably have standing water for a few days to a month or more at the beginning of the growing season, i. e. they are seasonally flooded (Cowardin et al. 1979). This type usually constitutes an encircling, though often discontinuous, vegetation band about these depression and ponds. The dominant visual aspect of a dense rhizomatous grassland is contributed by *Pascopyrum smithii* (western wheatgrass) with a lower layer of much more discontinuous coverage of *Carex duriuscula* (needleleaf sedge).

Environment: This association characteristically occurs in deeper swales and as one of mostly concentric zones around prairie potholes; it was noted only infrequently to be associated with the riparian zone. Because the bulk of these sites were surveyed in the droughty year of 2000 there was no standing water at the time of visitation (even the depression centers often were not flooded) and thus the water regime was difficult to determine. However, old wrack lines and silt deposits were sometimes noted, indicating that flooding had occurred. The soils most often were silt loams, silts, and silty clays. The next wetter zone often is occupied by following herbaceous wetland types, *Pascopyrum smithii - Eleocharis* spp., *Eleocharis palustris* or *Eleocharis acicularis*. Drier positions on this gradient are often characterized as true upland sites with *Elymus lanceolatus - Nassella viridula* (or *Pascopyrum smithii - Nassella viridula*) and *Elymus lanceolatus - Hesperostipa comata* being the dominant vegetation types.

Vegetation: The vegetation is generally species poor, consisting of a thick sward of *Pascopyrum smithii* with a highly variable cover of *Carex duriuscula*. We noted that cattle appeared to preferentially graze the *Carex duriuscula*, even with healthy *Pascopyrum smithii* present. Occasionally these sites had scattered *Distichlis stricta* and *Hordeum jubatum*. The most constant forb was *Aster falcatus*.

Comments: There is a *Pascopyrum smithii* Habitat Type described by Hansen et al. (1995) for Montana that apparently occurs throughout the Intermountain West but neither their description nor their constancy-cover tables allude to the vegetation condition we have encountered in Valley and Phillips Counties. That is, none of these studies describe a co-dominance by *Carex duriuscula* and it is unclear just what landscapes they sampled to arrive at their classification but clearly the *Pascopyrum smithii* plant association from Idaho, Utah, and Washington would not have a Great Plains floristic component as does *Pascopyrum smithii - Carex duriuscula*.

Element Sources

Author(s): Cooper, S. V. and C. Jean, MTNHP

Confidence: 3

References: Cooper et al. 2001, Hansen et al. (1995)

***Pascopyrum smithii - Eliocharis* spp. Herbaceous Vegetation**
Western Wheatgrass - Spikerush species Herbaceous Vegetation
Global Rank: G1 State Rank: S1?
Element Code: CEGL001581

Element Concept

Summary: This association includes stands of herbaceous vegetation growing in periodically inundated, small playas on the northern Great Plains. The sites supporting this association are closed basins (playas) of <1 ha with fine-textured soils that impede drainage; consequently the playas are flooded periodically. The small basins supporting this association have standing water during "the wet seasons," presumably meaning mainly in the spring and also after heavy summer rains. *Pascopyrum smithii* and *Eleocharis* spp. (*Eleocharis acicularis* or *Eleocharis palustris* or both) dominate the vegetation, and *Hordeum brachyantherum*, *Juncus balticus*, and *Alopecurus* spp. often are present. Stands of this type typically include two zones, resulting from differences in the period of inundation. The lowest part of the stand, which is inundated most often and for the longest time, is dominated by *Eleocharis acicularis*, and may contain *Hordeum brachyantherum*, *Juncus balticus*, and *Alopecurus aequalis* or *Alopecurus carolinianus*, and bare soil accounts for about 75% of the ground surface; the higher part of the stand is dominated by *Pascopyrum smithii* and may contain substantial amounts of *Carex douglasii* and *Vulpia octoflora* var. *octoflora* (= *Festuca octoflora*). The species common in the surrounding vegetation are absent from stands of this type, or contribute little cover.

Vegetation: This type includes low herbaceous vegetation growing in closed basins. *Pascopyrum smithii* and *Eleocharis acicularis* generally dominate, and the plants common in the surrounding steppe generally are absent or contribute very little cover. Stands of this type typically include two zones, resulting from differences in the period of inundation. The following information is from two stands surveyed by Jones (1997): the lowest part of the stand, which is inundated most often and for the longest time, is dominated by *Eleocharis acicularis* and may contain *Hordeum brachyantherum*, *Juncus balticus*, and *Alopecurus aequalis* or *Alopecurus carolinianus*, and bare soil accounts for about 75% of the ground surface; the higher part of the stand is dominated by *Pascopyrum smithii* and may contain substantial amounts of *Carex douglasii* and *Vulpia octoflora* (= *Festuca octoflora*). According to Thilenius et al. (1995), *Hordeum jubatum* occurs on the margins of the stands.

Similar Associations: *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582)—stands are dominated or co-dominated by *Pascopyrum smithii*, but *Eleocharis acicularis* is absent and *Hordeum jubatum* is a major species. Stands occur in playas where the subsoils contain higher concentrations of sodium (Paris and Paris 1974, Bergman and Marcus 1976). Holpp (1977) described vegetation from 10 playas in Campbell County, Wyoming that seem very similar to the playas containing this association. His stands generally were dominated by *Pascopyrum smithii* and contained some wetland species (*Juncus balticus, Alopecurus carolinianus*), but they showed no consistency in species composition and none contained *Eleocharis acicularis*.

Comments: Species composition varies among stands of this type depending on the degree of inundation, but the degree of variation is unknown. More stand data might indicate that this association and *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582) should be combined as it also occupies small playas.

Element Distribution

Range: This association has been described from a small area (ca. 250 square miles) in northeastern Wyoming, mainly on the divide between the Belle Fourche River drainage and the Cheyenne River drainage. Two stands apparently have been described from the area of the Montana - South Dakota border as well (Hansen and Hoffman 1988, Table A-5, stands 61 and 136), suggesting that the range of the type may extend into southeastern Montana and western South Dakota. It has been confirmed from northcentral Montana, just south of the Saskatchewan border.

States/Provinces: MT:S1?, SD:S?, SK:S? WY:S1

Element Sources

References: Bergman and Marcus 1976, Bureau of Land Management 1979, Caballo Rojo Mine Application n.d., Hansen and Hoffman 1988, Hansen et al. 1984, Holpp 1977, Jones 1997, Mine Reclamation Consultants 1977, Paris and Paris 1974, Soil Conservation Service 1986, Thilenius et al. 1995, Western Resources Development Corporation n.d.

Authors: G.P. Jones, WCS

Confidence: 2

***Poa pratensis - (Pascopyrum smithii)* Semi-natural Herbaceous Vegetation**
Kentucky Bluegrass - (Western Wheatgrass) Semi-natural Herbaceous Vegetation
Global Rank: GW State Rank: S?
Element Code: CEGL005265

Element Concept

Summary: This Kentucky bluegrass type is potentially widespread throughout the Great Plains and into the midwestern United States and Canada, depending on how the type is defined. Stands can occur in a wide variety of human-disturbed and native habitats. The vegetation is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Poa pratensis*, considered to be both a native and naturalized species from Eurasia. Other native species may occur as well, but they are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (= Stipa comata)*, as well as others. Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such. This type includes only naturalized examples of *Poa pratensis* stands. Maintained lawns are treated as cultural types.

Comments: The debate over whether *Poa pratensis* is either native or introduced appears to be resolved in favor of it being both (Great Plains Flora Association 1986, Gleason and Cronquist 1991). The Great Plains Flora Association (1986) cites Boivin and Love (1960) as the source of this decision. Gleason and Cronquist (1991) state that in most parts of their Manual's range (Northeast and Midwest United States and adjacent Canada), the species is introduced, but that it is probably native along their northern boundary and in Canada.

This type could be narrowly restricted to mixed-grass prairie stands where *Poa pratensis* dominates to the exclusion of most other species, or it could be expanded to include almost any naturalized stand dominated by *Poa pratensis*. Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such. This type includes only naturalized examples of *Poa pratensis* stands. Maintained lawns are treated as cultural types.

Element Distribution

Range: This Kentucky bluegrass type is potentially widespread throughout the Great Plains and into the midwestern United States and Canada.

States/Provinces: MT:S?, ND:S?, SD:S?, WY:S?

Federal Lands: NPS (Badlands, Theodore Roosevelt, Wind Cave); USFWS (Lacreek)

Element Sources

References: Gleason and Cronquist 1991, Great Plains Flora Association 1986

Authors: D. Faber-Langendoen, MCS

Confidence: 3

Identifier: CEGL005265

Puccinellia nuttallians Herbaceous Vegetation

Nuttall's Alkali Grass Herbaceous Vegetation
Global Rank: G3? State Rank: S?
Element Code: CEGL001799

Element Concept

Summary: This wetland association is described from a high-elevation (2900 m) park in central Colorado and in southwestern and central Montana, but likely occurs elsewhere across the western and northern Great Plains and the western U.S. and Canada. While the dominant species occurs over a broad geographic range, it has quite specific habitat needs requiring moist soils of intermediate salinity in seasonally wet meadow habitats. Site topography is generally flat with poor drainage. In South Park, Colorado, there is often a small microtopography of hummocks which affects the water relations and therefore species composition. The soils are moist, saline and alkaline, derived from calcareous shales. The snow/rain- and groundwater-saturated soils usually dry out during the growing season. Communities form a ring just above the succulent plant associations associated with playas, salt flats and saline lakes, or may occur as patches along intermittent drainages. They exist in saline soils that range from 0.7-1% total salts. The pH levels are commonly very alkaline. The wetland vegetation is characterized by the dominance of *Puccinellia nuttalliana* in the graminoid layer. *Distichlis spicata* or *Hordeum jubatum* may codominate is some stands. The forb layer is relatively sparse and is often composed of *Salicornia rubra* or *Triglochin maritima*. Diagnostic of this herbaceous wetland association is the dominance of *Puccinellia nuttalliana*.

Element Distribution

Range: This association occurs on moist soils of intermediate salinity in seasonally wet meadow habitats of South Park, Colorado (Ungar 1974c). Possible stands of this association have been noted by researchers in the eastern (Nebraska) and northern plains regions to Saskatchewan and through the intermountain region to Utah and California (Ungar 1974c).

States/Provinces: CO:S1?, MT:S?, NV?, SD?, SK?, UT?

Element Sources

References: Bourgeron and Engelking 1994, Cooper et al. 1999, Dodd and Coupland 1966, Driscoll et al. 1984, Gersib and Steinauer 1991, Ungar 1970, Ungar 1972, Ungar 1974c, Young et al. 1986

Authors: D. Sarr, THE NATURE CONSERVANCY, WESTERN CONSERVATION SCIENCE, BOULDER, CO

Confidence: 2

Schoenoplectus acutus Herbaceous Vegetation

Hardstem Bulrush Herbaceous Vegetation
Global Rank: G5 State Rank: S5
Element Code: CEGL001840

Element Concept

Summary: This association is a common emergent herbaceous wetland found mostly in the interior western U.S. ranging from the Puget Sound of Washington to Montana south to California, Nevada and Utah. Stands occur along low-gradient, meandering, usually perennial streams, river floodplain basins, and around the margins of ponds and shallow lakes especially in backwater areas. Some sites are flooded most of the year with about 1 m of fresh to somewhat saline or alkaline water. Other sites, however, dry up enough in late summer to where the water table drops below the ground surface, though the soils are still partially saturated. Soils are generally deep, organic, alkaline, poorly drained and fine-textured, but range in soil textures from sand to clay to organic muck. The soils may be normal or saline. Vegetation is characterized by a dense tall herbaceous vegetation layer 1-3 m tall that is dominated by *Schoenoplectus acutus (= Scirpus acutus)*, often occurring as a near monoculture. Associated species include low cover of *Mentha arvensis, Polygonum amphibium, Sagittaria latifolia*, and species of *Carex, Eleocharis, Rumex*, and *Typha*. Early in the growing season or at permanently flooded sites, aquatic species such as *Potamogeton* spp. and *Lemna minor* may be present to abundant. Stands of this association contain no tree or shrub layer, but a few sites have been invaded by the introduced shrub *Tamarix* spp.

Comments: This association appears to be somewhat variable in flood regime. It is flooded less time than some of the other *Schoenoplectus acutus* associations in this semipermanently flooded alliance with some stands included in this association occurring in a seasonally flooded hydrologic regime. However, stands described by Kunze (1994) from western Washington were permanently flooded with shallow water (about 1 m deep). Additional research is needed to determine if the different hydrological regimes indicate a need to split out new associations.

Element Distribution

Range: This association is a common emergent wetland found mostly in the interior western U.S. from Washington to Montana south to California, Nevada and Utah.

States/Provinces: CA:S3?, ID:S4, MT:S5, NV:S?, OR:S5, UT:S?, WA:S4

TNC Ecoregions: 10:C, 11:C, 17:C, 2:C, 6:C

Element Sources

References: Bourgeron and Engelking 1994, Bundy et al. 1996, Dethier 1990, Driscoll et al. 1984, Evans 1989a, Hansen et al. 1991, Hansen et al. 1995, Kunze 1994

Authors: K.A. Schulz, THE NATURE CONSERVANCY, WESTERN CONSERVATION SCIENCE, BOULDER, CO

Confidence: 1

Northern Prairie Pothole Wetland Complex
Global Rank: G3G5 State Rank: S?
Element Code: CEGX005705

Element Concept

Summary: Northern prairie wetland complexes occur widely throughout the glaciated northern Great Plains of the United States and Canada. They are responsible for a significant percentage of the annual production of many economically important waterfowl in North America. Prairie potholes are mostly closed basins that receive irregular inputs of water from their surroundings (groundwater and precipitation), and export water as groundwater. Climate of the region is characterized by mid-continent temperature and precipitation extremes, with areas in the region having summer highs of over 38 degrees C and winter lows below -40 degrees C. Precipitation ranges from over 56 cm in the southeast to barely 25 cm along the western edge of the region. The prairie pothole region is covered by a thin mantle of glacial drift overlying stratified sedimentary rocks of Mesozoic and Cenozoic ages. Hydrology of the potholes is complex. Precipitation and runoff from snowmelt are often the principal water sources, with groundwater inflow secondary. Evapotranspiration is the major water loss, with seepage loss secondary. Most of the wetlands and lakes contain water that is alkaline (pH >7.4). The concentration of dissolved solids in these waters ranges from fresh to extremely saline. On the basis of phosphorus supply and concentration of phosphorus, many of these wetlands are eutrophic. Chemical characteristics, especially of the larger ponds (>5 ha) and lakes, vary both seasonally and annually. Because surface water chemistry can change dramatically in prairie lakes and wetlands, it can be difficult to classify a body of water into a particular salinity type. The flora and vegetation of a prairie wetland is a function of the water regime, salinity, and disturbance by humans. Within a pothole, water depth and duration determines the local gradient of species. Potholes deep enough to have standing water, even during droughts, will have a central zone of submersed aquatics (open water). In wetlands that go dry during periods of drought or annually, the central zone will be dominated by either tall emergents (deep marsh) or mid-height emergents (shallow marsh), respectively. Potholes that are only flooded briefly in the spring are dominated by grasses, sedges, and forbs (wet meadow). A distinct drawdown zone will also occur. The depth of the deepest part of the pothole and the relative steepness of the local relief will determine how many zones occur in a given pothole. These patterns are impacted by the extent of drainage, grazing, mowing, and burning occurring in the pothole, and by sedimentation, nutrient runoff, and pesticides from adjacent plowing. In addition, because of periodic droughts and wet periods, many wetlands undergo vegetation cycles.
The combination of vegetation cycles and diffuse zonation patterns makes classification of prairie pothole wetlands difficult. The prairie pothole complex proposed here is an alternative means of applying the U.S. National Vegetation Classification (USNVC) to prairie potholes. The complex is still a preliminary idea and could take several approaches, based on ecoregional and water chemistry patterns. Regardless of the approach chosen, it should still be possible to describe the characteristic vegetation of the complex using the USNVC associations.

Environment: Prairie potholes are mostly closed basins that receive irregular inputs of water from their surroundings, and export water as groundwater. Climate of the region is characterized by mid-continent temperature and precipitation extremes, with areas in the region having summer highs of over 38 degrees C and winter lows below -40 degrees C. Precipitation ranges from over 56 cm in the southeast to barely 25 cm along the western edge of the region. Wetlands typically fill in the spring, when snowmelt runs off the frozen soil. The prairie pothole region is covered by a thin mantle of glacial drift overlying stratified sedimentary rocks of Mesozoic and Cenozoic ages. The rocks consist primarily of limestones, sandstones, and shales. Highly mineralized water can discharge upward from these sedimentary rocks into the glacial drift. The geomorphology of the drift consists of end moraines, stagnation moraines, ground moraines, outwash plains, and lakeplains. The drift is thickest in areas of end and stagnation moraines, generally 60 to 120 m. In areas of ground moraines and lakeplains, the drift is generally less than 30 m thick. The drift is generally fine-grained, silty and clayey soils. The end and stagnation moraines can rise up from 10 to greater than 100 m above the surrounding flatter plains, creating relatively steep local relief. On other drift, the land slopes are slight, and local relief may only be a few meters (Winter 1989).
Hydrology of the potholes is complex. The generally low land surface relief results in low runoff velocities. Numerous small depressions in morainal areas are not part of an integrated drainage system, and contribute little to stream flow. Finally, because the geological materials have low permeability, infiltration also is minimal. Infiltration is further limited because climatic conditions are such that soil frosts are usually deep (1 to 1.3 m), causing spring

snowmelt to run off into the potholes until they would overflow from one pothole to the next. Groundwater recharge and discharge can lead to areas of seepage, as topographically high wetlands discharge into adjacent lower areas. This can lead, e.g., to freshwater springs discharging into saline lakes. Both the spring melt and groundwater phenomenon illustrate how pothole hydrology is best studied when the wetlands complexes are treated as interconnected hydrologic units (Winter 1989).
Precipitation and runoff from snowmelt are often the principal water sources, with groundwater inflow secondary with about 15% of total inflow. Evapotranspiration is the major water loss, with seepage loss only about 15-20% of total outflow (Winter 1989).
Most of the wetlands and lakes contain water that is alkaline (pH >7.4), and pH values of 10.8 have been reported. The concentration of dissolved solids in these waters ranges from fresh to extremely saline. Calcium, magnesium, sodium, and potassium have each been determined to be the most abundant cations in these prairie wetlands, and bicarbonate, sulfate, and chloride the most abundant anions. The least saline waters commonly are a calcium bicarbonate type, and the most saline waters commonly are a sodium sulfate type. However, water type and salinity are independent. On the basis of phosphorus supply and concentration of phosphorus, many of these wetlands are eutrophic (Labaugh 1989).
Chemical characteristics vary both seasonally and annually, especially in larger potholes (>5 ha). Seasonal variation in major ions is affected by concentration under ice cover, dilution due to snowmelt and runoff, concentration by evaporation, dilution from rainfall, and interaction with groundwater. A variety of classifications exist in the literature with respect to salinity. The most widely used in the U.S. was that of Stewart and Kantrud (1972), who based their scale on the correlation between distinctly different plant communities and the relative concentrations of dissolved solids, indicated by specific conductance. Their categories were fresh (<500 uS/cm), slightly brackish (500-2000 uS/cm), moderately brackish (2000-5000 uS/cm), brackish (5000-15,000 uS/cm), subsaline (15,000-45,000 uS/cm), and saline (>45,000 uS/cm). Millar (1976) used a similar approach in western Canada, but defined four categories: fresh (<1400 ppm or <2000 uS/cm), moderately saline (1400-10,500 ppm), saline (10,500-31,500 ppm) and hypersaline (>31,500 ppm). Numerous wetlands and lakes in the northern prairies are more saline than the ocean (approximately 50,000 uS/cm). Because surface water chemistry can change dramatically in prairie lakes and wetlands, it can be difficult to classify a body of water into a particular salinity type (Labaugh 1989).

Vegetation: The flora of a prairie wetland is a function of the water regime, salinity, and disturbance by humans. Within a pothole, water depth and duration determine the local gradient of species. Potholes deep enough to have standing water, even during droughts, will have a central zone of submersed aquatics (open water). In wetlands that go dry during periods of drought, or annually, the central zone will be dominated by either tall emergents (deep marsh) or mid-height emergents (shallow marsh), respectively. Potholes that are only flooded briefly in the spring are dominated by grasses, sedges, and forbs (wet meadow). The depth of the deepest part of the pothole and the relative steepness of the local relief will determine how many zones occur in a given pothole. These patterns are impacted by the extent of drainage, grazing, mowing, and burning occurring in the pothole, and by sedimentation, nutrient runoff, and pesticides from adjacent plowing (Kantrud et al. 1989).
Because of periodic droughts and wet periods, many wetlands undergo vegetation cycles. Periods of above normal precipitation can raise water levels high enough to drown out emergent vegetation or produce “eat outs” due to increases in the size of muskrat populations that accompany periods of high water (Kantrud et al. 1989). The elimination of emergents creates an open-water marsh, dominated by submerged aquatics. During the next drought when the marsh bottom is exposed by receding water levels (a drawdown), seeds of emergents and mudflat annuals in the soil seed bank germinate (dry marsh). When the marsh refloods, the emergents survive and spread vegetatively (Kantrud et al. 1989).
Zonation patterns are conspicuous in prairie potholes, because each zone often is dominated by a single species that has a lifeform different from those in adjacent zones. But each zone is constantly adjusting to the shifting environmental gradients within the pothole, which can create a lag in response among various species, and cloud the compositional patterns within the zones (Kantrud et al. 1989, Johnson et al. 1987). The combination of vegetation cycles and clouded zonation patterns makes classification of prairie pothole wetlands difficult.

Dynamics: Floods can occur during spring melt, because soil frosts are usually deep (1-1.3 m). This causes the spring snowmelt to run off into the potholes until they overflow prominent potholes (Winter 1989). Because of periodic droughts and wet periods, many prairie wetlands undergo vegetation cycles. Periods of above normal precipitation can raise water levels high enough to drown out emergent vegetation or cause them to be eaten out by

muskrat populations that increase during periods of high water (Kantrud et al. 1989). Wave action can also cause disturbances of the shoreline vegetation. During the next drought when the marsh bottom is exposed by receding water levels (a drawdown), seeds of emergents and mudflat annuals in the soil seedbank germinate (dry marsh). When the marsh refloods, the emergents survive and spread vegetatively (Kantrud et al. 1989).
The drawdown zone is particularly dynamic. Vegetation tends to be more sparse around permanent ponds and more dense in temporary ponds. The zone is typically inundated early in the season, but is generally dry by late spring or early summer. The vegetation is often very diverse, since drawdowns happen to varying degrees from year to year. Prairie fires could also be expected to sweep through these wetlands, particularly during drawdown periods.

GRank & Reasons: G3G5 (00-01-31). This rank has been assigned based on the widespread distribution of the complex, the commonness of many of the component associations, and the high rank of a few associations. Thus individual potholes typically do not contain rare vegetation types, but some may. Many potholes are small, landscapes have been extensively ditched for drainage, and farming and ranching activities can lead to plowing, high levels of nutrient run-off and siltation, or heavy grazing.

Comments: The complex proposed here is an alternative to applying the USNVC to prairie pothole wetlands. The USNVC, like that of the national wetland classification (Cowardin et al. 1979), in principal classifies each zone as a separate association or wetland type, respectively. By contrast, Stewart and Kantrud (1972) developed a classification system of prairie potholes that recognized different phases of vegetation zones dominated by the major lifeforms in each, from open water to wet meadow. They also used the composition of the zone as an indicator of the water regime, water chemistry and disturbance. Each pothole was assigned to a type based on the deepest part (zone).
The prairie pothole complex proposed here relies in part on the method of Stewart and Kantrud (1972). The complex is still a preliminary idea, and could take several approaches. First, the complex could be treated most broadly as a single unit, putting all wetlands across the entire region into a single unit. Second, the complex could be subdivided into major subregions. Three possibilities, suggested by D. Ode (pers. comm. 1999) are: (1) Tallgrass Prairie/Aspen Parkland Region (Province 251), where a higher proportion of open water and deep emergent marshes with fresh water chemistry occur; (2) James Basin and Missouri Coteau Region (Province 332), where the vast majority of wetlands are shallow marsh and wet meadow types; and (3) Northwestern Region (Province 331), where brackish and saline types predominate. Finer divisions at section or subsection levels would also be possible and have been used in Alberta (L. Allen pers. comm. 1999).
Third, the complex could be defined based on the deepest zone within a complex, following Steward and Kantrud (1972). There would be the following subtypes: (1a) open marsh, freshwater complex; (1b) open marsh, brackish/saline complex; (2a) deep marsh, freshwater complex; (2b) deep marsh, brackish/saline complex; (3a) shallow marsh, freshwater complex; (3b) shallow marsh, brackish/saline complex; (4a) wet meadow, freshwater complex; (4b) wet meadow, brackish/saline complex; (5a) fens/seeps, freshwater complex; (5b) fens/seeps, brackish/saline complex; (6a) drawdown, freshwater complex; (6b) drawdown brackish/saline complex. Individual associations found within each of these complexes would then be listed (see below). Any combination of these options is also possible. Regardless of the approach taken, a complete list of associations found within a given complex can be developed, and a first start at a comprehensive list across the entire range of complexes is provided below, categorized by Steward and Kantrud's categories.
Sandhill prairie wetlands in northwestern Nebraska could be considered another kind of prairie pothole wetland complex. They are not glaciated and are located in areas of sand dunes. Northern glaciated prairie lakes (approximately >8 ha or 20 acres in size, and over 2 m deep using Cowardin et al. 1979 criteria) are not included in this wetland complex.

Element Distribution

Range: This complex occurs widely throughout the glaciated northern Great Plains of the United States and Canada. The range can be approximated by referring to Bailey's (1994) U.S. Ecoregional Section map. It covers the northern parts of Provinces 251 (251A?,251B), 332 (332A,332B,332D), and 331 (331D, 331E) in western Minnesota, eastern South Dakota and North Dakota, and extreme northern Montana, as well their equivalents in southwestern Manitoba, southern Saskatchewan and southeastern Alberta (see Bailey 1997).

Nations: CA US

States/Provinces: AB:S?, MB:S?, MT:S?, ND:S?, NE?, SD:S?, SK:S?, WY:S?

Element Sources

References: Johnson et al. 1987, Kantrud et al. 1989, Labaugh 1989, Millar 1976, Stewart and Kantrud 1972, Winter 1989

Authors: D. Faber-Langendoen, MCS

Confidence: 2

Identifier:

Appendix D. Site Descriptions from Field Assessments of Natural Potholes

5042 Site 1 NW 1

LOCATION
Site survey 5042 Site 1 NW 1 is located at T36N R29E Sec. 10 SE of NW. From Malta go north on 191 to Loring. From here go north on 191 and take first county road on left, proceed to where the road goes due west and go about two more miles, walk to the north.

RICHNESS
This is for a cluster of five wetlands in undulating terrain. The wetlands are in shallow basins that are at the time of sampling dry. The wettest portion of this wetland is a common spikesedge (*Eleocharis palustris*) habitat type and next in dryness is a western wheatgrass (*Pascopyrum smithii*) habitat type. Wetland three is similar though in this case I called its only community a common spikesedge (*Eleocharis palustris*) habitat type even though *Eleocharis palustris* only had a cover of 01. Needle spikerush (*Eleocharis acicularis*) had a coverage of 70. Wetland two was also sampled and has a *Pascopyrum smithii* habitat type and it is similar to wetlands four and five. The uplands in both cases were vegetated with an assortment of blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands.

KEY ENVIRONMENTAL FACTORS
These wetlands have very small catchment basins and usually fill in spring. Occasional summer storms will also fill them. Surface runoff is the water source and surface runoff is how it leaves.

RARITY
No rare plants or plant communities were seen.

CONDITION
There has been light grazing pressure and I placed cow pie coverage between 03 and 10. No non-native plants were present. These wetlands are in proper functioning condition and the soil was dry.

5042 Site 2 NW 1

LOCATION
Site survey 5042 Site 2 NW 1 is at T36N R29E Sec. 10 NW of NE. From Malta take 191 north to Loring. From Loring take the first county road on the left and proceed to where the road goes due west. Go about two miles and walk north.

RICHNESS
This wetland has a catchment basin of about three square miles. I found two communities. The wettest was a common spikesedge (*Eleocharis palustris*) habitat type. The other community found here is a foxtail barley (*Hordeum jubatum*) community type. Blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands dominate the gently undulating uplands.

KEY ENVIRONMENTAL FACTORS
Surface runoff water usually floods this wetland in the spring and at times from summer storms. The outlet again leads to surface flow.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site is in good condition except for the *Eleocharis palustris* community, which was heavily pugged. The soil in this community was moist. During times of the bison the community probably looked the same. The cow pie coverage was 01 for both communities. Because of these observations I classified the area as being in proper functioning condition. Two non-native plant species were found here with a cover of 01, these are Canada thistle (*Cirsium arvense*) and goat's beard (*Tragopogon dubius*).

5041 Site 1 NW 1

LOCATION
Site survey 5041 Site 1 NW 1 is at T36N R29E Sec. 11 SW of NE. From Malta take 191 north to Loring. Continue to the first county road on the left and proceed to where the road goes due west. Walk north then northwest to the plot.

RICHNESS
Surface runoff from gently undulating land usually floods this wetland in the spring and also at times from summer storms. The outlet is also surface flow. Plant communities found here are a common spikesedge (*Eleocharis palustris*) habitat type in the wettest portion and a foxtail barley (*Hordeum jubatum*) community type in the drier part. The soil was dry throughout the site. Uplands are vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring and from summer storms usually contributes water to this wetland.

RARITY
No rare plants or plant communities were seen.

CONDITION
There is evidence of cattle grazing last year with cow pie coverage of 01. I rated the site as being in proper functioning condition. The only exotic plant was Canada thistle (*Cirsium arvense*) with coverage of 01.

5041 Site 1 NW 3

LOCATION
Site survey 5041 Site 1 NW 3 is at T36N R30E Sec. 29 NE of NW. From Malta take 191 north to Loring. Continue north about four miles to a gravel road to the right. The site is on the left side of 191.

RICHNESS
This wetland is in a narrow shallow valley. The uplands are vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wettest community is a common spikesedge (*Eleocharis palustris*) habitat type. Foxtail barley had a low coverage in the center of this community and it increased towards the outside edge though *Eleocharis palustris* always dominated. The next driest community is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff in spring and from summer storms usually provides most of the water for this wetland.

RARITY
No rare plants or plant communities were seen.

CONDITION
The soil here was slightly moist. Cow pies had a coverage of 01 and I rated the wetland as being in proper functioning condition. Exotic plant species found here are Canada blue grass (*Poa compressa*) and Kentucky blue grass (*Poa pratensis*) both with low coverage.

5037 Site 1 NW 3

LOCATION
Site survey 5037 Site 1 NW 3 is at T35N R30E Sec. 3 SW of NE. From Malta head north on 191 to Loring. Continue about four miles to a gravel road on the right. Go down this road about 1.5 miles to a gate. Walk to the site from here.

RICHNESS
The wetland is in very gently rolling land. Surface runoff feeds the wetland that can get about one foot of water before it overflows. The soil was dry when sampled. The uplands are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Two plant communities were here with the wettest being a small sample of a common spikesedge (*Eleocharis palustris*) habitat type and then a larger and drier western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff in the spring and occasionally during summer storms usually supplies most of the water for this wetland.

RARITY
No rare plants or plant communities were seen here.

CONDITION
This wetland was rated as being in proper functioning condition. Cow pie coverage was 03 and there was about a two-inch stubble from this years grazing. Field cottonrose (*Logfia arvense*) was the only exotic plant species.

5037 Site 2 NW 3

LOCATION
Site survey 5037 Site 2 NW 3 is at T35N R30E Sec. 3 SW of NE. From Malta take 191 north to Loring. From here go about four miles north to a road of the right. Go down this road about 1.5 miles to a gate and walk to the site from there.

RICHNESS
The topography at this site is very gently undulating. The uplands are dominated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Water gets about six inches deep in wet years before overflowing. A western wheatgrass (*Pascopyrum smithii*) habitat type was the only community in the three wetlands at this site.

KEY ENVIRONMENTAL FACTORS
Surface runoff in the spring and from summer storms usually provides the water for these wetland which when they overflow provide surface runoff for sites further down the drainage.

RARITY
No rare plants or plant communities were seen.

CONDITION
I rated these wetlands as being in proper functioning condition. The soil was dry and the cow pie coverage was 03. The only exotic plant species was common dandelion (*Taraxacum officinale*).

5037 Site 3 NW 3

LOCATION
Site survey 5037 Site 3 NW 3 is at T36N R30E Sec. 33 SW of NE. From Malta go north on 191 to Loring. From here go another four miles to a gravel road on the right. Take this road 1.5 miles to a gate. Park here and walk to the site.

RICHNESS
The gently undulating uplands are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland had two communities with the wettest being common spikesedge (*Eleocharis palustris*) habitat type and the drier with a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring and from summer storms usually provides most of the water to this wetland. The outflow goes to surface runoff.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as functional-at risk due to the presence of two stock ponds dug into the wetland, which takes water the site, would normally get. The soil was dry in the sample area and the cow pie coverage was 01. An allotment fence also goes through the wetland. Non-Native plant species found here are Kentucky bluegrass (*Poa pratensis*), fowl bluegrass (*Poa palustris*), goat's beard (*Tragopogon dubius*), and common dandelion (*Taraxacum officinale*). All have a coverage of 01.

5037 Site 4 NW3

LOCATION
Site survey 5037 Site 4 NW3 is at T36N R30E Sec. 34 NW of SW. From Malta go north on 191 to Loring. From here go about four miles to a gravel road on the right. Take this road for about 1.5 miles to a fence. Park here and walk the site.

RICHNESS
The rolling terrain surrounding this site is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has two communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest portion and a western wheatgrass (*Pascopyrum smithii*) habitat type on the drier outer edge.

KEY ENVIRONMENTAL FACTORS
Surface runoff in the spring and from summer storms usually provides most of the water to this wetland. Water can get to four feet deep before the wetland overflows creating more surface runoff.

RARITY
No rare plants and plant communities were seen.

CONDITION
I ranked this wetland as being n proper functioning condition. However, it has about a two-foot high dam that serves as a road. Cow pies had a coverage of 03 and there was a six-inch stubble height. Bull thistle (*Cirsium vulgare*) and common plantain (*Plantago major*) were present with a coverage of 01.

5158 Site 1 NW 3

LOCATION
Site survey 5158 Site 1 NW 3 is at T35N R30E Sec. 4 SW of NE. From Malta go north on 191 to Loring then go four more miles to a gravel road on the right. Take this road about 1.5 miles to a gate and walk to the site.

RICHNESS
The gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. In the wetland the wettest portion has a common spikesedge (*Eleocharis palustris*) habitat type and a western wheatgrass (*Pascopyrum smithii*) habitat type on the drier part.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring and occasionally from summer storms usually provides most of the water for this wetland.

RARITY
No rare plants or plant communities were seen.

CONDITION
A stock pond was dug in a neighboring wetland and a trench was then dug to this one. Water that went into these two wetlands now goes into the stock pond and due to this the site was rated as functional-at risk. Cow pie coverage ranged form 01 to 03. The only non-native plant was goat's beard (*Tragopogon dubius*) with a coverage of 01.

5058 Site 1 NW 3

LOCATION
Site survey 5058 Site 1 NW 3 is at T35N R30E Sec. 4 NW of SW. From Malta go north on 191 to Loring and then go about four miles to a gravel road on the right. Take this road for about 1.5 miles to a gate and walk to the site.

RICHNESS
The gently rolling uplands by this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) plant communities. Three wetlands are represented here all being similar in composition. The wettest portion of these wetlands is vegetated with a common spikesedge (*Eleocharis palustris*) habitat type while the drier portion has a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff in the spring and from summer storms usually provides most of the water to these wetlands.

RARITY
No rare plants or plant communities were seen.

CONDITION
These wetlands were rated as being in proper functioning condition. Cow pie coverage was 03. Non-native plants were common dandelion (*Taraxacum officinale*), goat's beard (*Tragopogon dubius*), and fowl bluegrass (*Poa palustris*) with a coverage of 10. The other two had a coverage of 01.

5037 Site 1 NW 4

LOCATION
Site survey 5037 Site 1 NW 4 is at T35N R30E Sec. 15 NE of SW. From Malta head north on 191 to Loring and continue about four miles to a gravel road on the right. Take this road about 1.5 miles to a fence and walk to the site.

RICHNESS
This is a large alkaline meadow with a 40 % surface coverage of bare soil. The only plant community here is an inland saltgrass (*Distichlis spicata*) habitat type.

KEY ENVIRONMENTAL FACTORS
This site probably receives surface runoff in the spring and during summer storms. Yet most of the water probably comes from seepage. The surface has small hummocks and the soil was moist.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. There were no non-native plant species and the cow pie coverage was 01.

5037 Site 2 NW 4

LOCATION
Site survey 5037 Site 2 NW 4 is at T35N R30E Sec. 10 SW of NE. From Malta go north on 191 to Loring and then go another four miles to a gravel road on the right. Follow it 1.5 miles to a gate and walk to the site.

RICHNESS
Two wetlands are represented here. They are in a broad bottomed ravine with no stream channel. The uplands are rolling and vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*). Wetland number one has a common spikesedge (*Eleocharis palustris*) habitat type in the wettest portion and in the drier part a western wheatgrass (*Pascopyrum smithii*) habitat type. The other wetland only has a *Pascopyrum smithii* habitat type.

KEY ENVIRONMENTAL FACTORS
These wetlands usually receive surface runoff in the spring and from summer storms. The water can get about one foot deep before overflowing, creating more surface runoff. The soil was dry.

RARITY
No rare plants or plant communities were seen.

CONDITION
These wetlands were rated as being in proper functioning condition. Cow pie coverage ranged from 03 to 10 and there was a one-inch stubble height.

5037 Site 3 NW 4

LOCATION
Site survey 5037 Site 3 NW 4 is at T35N R30E Sec. 10 SW of NE. From Malta go north on 191 to Loring and then go about another four miles to a gravel road on the left. Go down this road for about 1.5 miles to a gate and then walk to the site.

RICHNESS
Three wetlands are represented here in gently rolling terrain vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) communities. Only a western wheatgrass (*Pascopyrum smithii*) habitat type is found here.

KEY ENVIRONMENTAL FACTORS
Surface runoff in the spring and from summer storms usually supplies most of the water to these wetlands. Water depth can get to about one foot before overflowing in wet years. The soil was dry

RARITY
No rare plants or plant communities were seen.

CONDITION
The site is rated as being in proper functioning condition. Cow pie coverage is 10 and stubble height is three inches.

5037 Site 4 NW 4

LOCATION
Site survey 5037 Site 4 NW 4 is at T35N R30E Sec. NW of SE. From Malta go north on 191 to Loring and then go about another four miles to a gravel road on the right. Take this road for about 1.5 miles to a gate and walk from there.

RICHNESS
The rolling landscape around this site is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) plant communities. The wetland in its wettest portion has a common spikesedge (*Eleocharis palustris*) habitat type and the drier part has a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring usually supplies water to this wetland and it also can get some form summer storms. The soil was dry. In wet years the water can get two feet deep before overflowing.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. The cow pie coverage was 10 and the stubble height was three inches. There were no exotic plant species.

5037 Site 5 NW 4

LOCATION
Survey site 5037 Site 5 NW 4 is at T35N R30E Sec. 10 SE of NE. From Malta go north on 191 to Loring and then about four miles beyond to a gravel road on the right. Travel down this road about 1.5 miles to a fence and then walk to the site.

RICHNESS
Two wetlands are represented here in a depression surrounded by rolling uplands vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has a common spikesedge (*Eleocharis palustris*) habitat type in its wet part and a western wheatgrass (*Pascopyrum smithii*) habitat type in the dry portion.

KEY ENVIRONMENTAL FACTORS
The site usually receives water in the spring or during summer storms in the form of surface runoff. The wetland would need to have water eight feet deep for it to overflow. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being functional-at risk due to a dam up hill of the site that intercepts water that these wetlands would otherwise get. Cow pie coverage varied from 03 to 10 and the stubble height was two to six inches. There were no non-native plant species.

5059 Site 1 NW 4

LOCATION
Site survey 5059 Site 1 NW 4 is at T35N R30E Sec. NE of NW. From Malta go north to the Whitewater exit. Go to Whitewater where the site is to the north west.

RICHNESS
Dibble Reservoir is surrounded by rolling terrain vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. In the wet portion of the wetland is an inland saltgrass (*Distichlis spicata*) habitat type. This community was dominated by Nuttall's alkaligrass (*Puccinellia nuttalliana*) and *Distichlis spicata* is not present where the sample plot was placed. It could be that it has not moved into this new site yet. On the drier portions of this wetland is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
I am not sure what type of plant community was here prior to the construction of Dibble Reservoir. It appears that the plant communities that were sampled are still adjusting to the new hydrologic situation. Water for the wetland usually comes from surface runoff in the spring and from summer storms. The soil was moist when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site is a reservoir, has excavated duck ponds and nesting structures, and is a cattle enclosure. It was given a proper functioning condition rating despite its problems. There were no cow pies. Exotic plants seen were summer cypress (*Kochia scoparia*), wild lettuce (*Lactuca* spp.), and goat's beard (*Tragopogon dubius*). *Kochia scoparia* had the highest coverage with a reading of 03. A large patch of Canada thistle (*Cirsium arvense*) was seen in a different portion of this large wetland.

5062 Site 1 NW 5

LOCATION
Site survey 5062 Site 1 NW 5 is at T35N R31E Sec. 17 NE of SE. From Malta take 191 north to the Whitewater exit and go to Whitewater. The site is to the northwest.

RICHNESS
Gently rolling terrain surrounds this wetland. Blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands surround the site. The wettest portion of the wetland has a common spikesedge (*Eleocharis palustris*) habitat type while the drier portion is vegetated with a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring and from summer storms usually provides most of the water to this wetland. The soil was moist from recent rains.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as functional-at risk. One stock pond and two duck habitat improvements are located here removing water that the wetland would otherwise receive. Cow pie coverage ranged from 01 to 03 and the *Eleocharis palustris* was grazed to a one-inch stubble. The only non-native plant was goat's beard (*Tragopogon dubius*) with a cover of 01.

5062 Site 2 NW 5

LOCATION
Site survey 5062 Site 2 NW 5 is at T35N R31E Sec. 17 NE of NE. From Malta go north on 191 to the Whitewater turnoff and then go to Whitewater. The site is north west of here.

RICHNESS
The rolling terrain surrounding this site is vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wettest portion of the wetland has a common spikesedge (*Eleocharis palustris*) habitat type while the drier part has a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring and from summer storms usually provides most of the water to this wetland. The soil was moist from recent rains and water can get one foot deep in wet years before over flowing.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as being in proper functioning condition. Cow pie coverage was 01 and the stubble height was two to three inches. There were no non-native plants.

5062 Site 3 NW 5

LOCATION
Site survey 5062 Site 3 NW 5 is at T35N R31E Sec. 18 SW of NE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. The site is to the northwest.

RICHNESS
The rolling uplands surrounding this wetland are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grassland communities. The wettest portion of the wetland is vegetated by a common spikesedge (*Eleocharis palustris*) habitat type, the next driest portion by a western wheatgrass (*Pascopyrum smithii*) habitat type, and the driest by a short-beaked sedge (*Carex simulata*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff in the spring and during summer storms usually provides most of the water to this wetland. A recent storm has provided six inches of water in the deepest part.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as being in proper functioning condition. The cow pie coverage was 03 and the *Eleocharis palustris* community had a two-inch stubble height. There were no non-native plants.

5062 Site 4 NW 5

LOCATION
Site survey 5062 Site 4 NW 5 is at T35N R31E Sec. 18 NE of SE. From Malta go north on 191 to the Whitewater turnoff and then go to Whitewater. From Whitewater go northwest.

RICHNESS
The uplands around this community are vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) communities. With the wetland, the wettest portion has a common spikesedge (*Eleocharis palustris*) habitat type, next driest is a western wheatgrass (*Pascopyrum smithii*) habitat type, and the driest is a short-beaked sedge (*Carex simulata*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff during the spring and from summer storms usually provides most of the water to this wetland. The *Eleocharis palustris* community had one inch of surface water while the soil was moist in the other communities. This was from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as functional-at risk. A stock pond has been dug into it removing some of the water that the wetland would otherwise get. Cow pie coverage was 01 and stubble height varied from three to six inches. No non-native plants were seen.

5035 Site 1 NE 2

LOCATION
Site survey 5035 Site 1 NE 2 is at T37N R31E Sec. 20 NW of SE. From Malta go north on 191 to the Whitewater turnoff and proceed to Whitewater. From here go about 9.5 miles to just past where the road dips south of a large wetland and walk to the site.

RICHNESS
The very gently rolling uplands surrounding this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Three wetlands are covered here with short-beaked sedge (*Carex simulata*) being the only community in the wetlands.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually in the spring and occasionally from summer storms provides most of the water for these wetlands. Water can get a few inches deep before overflowing. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
These wetlands were rated as being in proper functioning condition. Cow pie coverage was 03. Two non-native plant species found here are common dandelion (*Taraxacum officinale*) and field cottonrose (*Logfia arvensis*).

5035 Site 2 NE 2

LOCATION
Survey site 5035 Site 2 NE 2 is at T37N R31E Sec. 20 NW of SE. From Malta go north on 191 to the Whitewater road and continue on it to Whitewater. Continue on this road about another 9.5 miles to where the road dips to the south below a large wetland and walk to the site.

RICHNESS
The very gently undulating terrain surrounding this site is vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has one community, which is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
This site usually gets most of its water from surface runoff in the spring and occasionally from summer storms. The water can get about one foot deep before it overflows. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage was 01 and field cottonrose (*Logfia arvense*) was the only non-native plant and had a coverage of 03.

5035 Site 3 NE 2

LOCATION
Site survey 5035 Site 3 NE 2 is at T37N R31E Sec. 20 SW of NE. From Malta go north on 191 to the Whitewater turnoff and proceed to Whitewater. From here go about 9.5 miles to where the road dips to the south of a large wetland and walk to the site.

RICHNESS
A gently rolling landscape surrounds this wetland that is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland, which is a reservoir, has four communities with a leafy pondweed (*Potamogeton foliosus*) community type in the aquatic portion, then a foxtail barley (*Hordeum jubatum*) community type, followed by a common spikesedge (*Eleocharis palustris*) habitat type, and in the dries portion a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
This reservoir appears to retain some water year round. The water depth can get about ten feet above current water levels. This site was probably vegetated with an upland grassland prior to construction and the communities are probably still adjusting to the new hydrologic regime. Surface runoff usually supplies water to this site in the spring and also occasionally from summer storms.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage ranged from 0 for the aquatic community to 03. Non-native plants found here include white sweet-clover (*Melilotus alba*) and common plantain (*Plantago major*).

5036 Site 1 NE 2

LOCATION
Site survey 5036 Site 1 NE 2 is at T36N R31E Sec. 29 NE of NW. From Malta go north on 191 to the Whitewater turnoff and continue to Whitewater. From here continue for about 9.5 miles to where the road dips to the south because of a large wetland and walk to the site.

RICHNESS
Two wetlands are covered here. They are surrounded by very gently undulating terrain and vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Only one community was found in the wetlands and it was a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water during the spring and occasionally from summer storms. Water depth in wet years probably does not exceed one foot in wet years. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage was 03. There were no non-native plants.

5036 Site 2 NE 2

LOCATION
Site survey 5036 Site 2 NE 2 is at T36N R31E Sec. 29 SW of NW. From Malta go north on 191 to the Whitewater turnoff and continue on to Whitewater. Continue on about 9.5 miles to where the road dips to the south as it goes around a large wetland and walk to the site.

RICHNESS
Very gently undulating terrain that is mostly vegetated with crested wheatgrass (*Agropyron cristatum*) and also with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Most of the water for this wetland usually comes as surface runoff in the spring and occasionally from summer storms. The soil was dry when sampled

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as functional-at risk. A large portion of the watershed has been planted to *Agropyron cristatum* and even a portion of the wetland may have been planted. The growth habitat of this species is very different from those found in native grasslands, which probably impacts the surface runoff the site depends on. Cow pie coverage was 01 and non-native species were *Agropyron cristatum* and goat's beard (*Tragopogon dubius*).

5036 Site 3 NE 2

LOCATION
Site survey 5036 Site 3 NE 2 is at T36N R31E Sec. 29 SW of SW. From Malta go north on 191 to the Whitewater turnoff and continue to Whitewater. From here continue for about 9.5 miles to where the road dips to the south for a large wetland and walk to the site.

RICHNESS
The rolling uplands surrounding this site are mostly vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Three plant communities were found here. The wettest is a common spikesedge (*Eleocharis palustris*) habitat type, then a western wheatgrass (*Pascopyrum smithii*) habitat type in a narrow band, and in a potential seepage area an inland saltgrass (*Distichlis spicata*) habitat type. Whitewater Creek borders this community.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water along with an occasional summer storm to the first two communities while the *Distichlis spicata* probably depends on seepage.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage ranged from 01 to 03 and Kentucky bluegrass (*Poa pratensis*) was the only non-native plant with a coverage of 01.

5036 Site 4 NE 2

LOCATION
Site survey 5036 Site 4 NE 2 is at T36N R31E Sec. 29 SE of SE. From Malta go north on 191 to the Whitewater turnoff and follow the road to Whitewater. From Whitewater continue for about 9.5 miles to where the road dips to the south for a wetland and walk to the site.

RICHNESS
The gently undulating terrain of this site is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*). The wetland itself is vegetated with a common spikerush (*Eleocharis palustris*) habitat type in the wetter portions and a western wheatgrass (*Pascopyrum smithii*) habitat type in the drier parts.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually floods this wetland in the spring and occasionally summer storms can also flood the site. The soil was moist from an over night rain at the time of sampling.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as functional-at risk due to the presence of a stock pond that takes water the wetland would otherwise get. Cow pie coverage varied from 01 to 03. There were no non-native plants seen.

5036 Site 5 NE 2

LOCATION
Site survey 5036 Site 5 NE 2 is at T36N R31E Sec. 33 NE of NE. From Malta go north on 191 to the Whitewater turnoff and proceed to Whitewater. From Whitewater go about six miles north and walk to the site.

RICHNESS
Gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has three communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest position and when sampled with six to twelve inches of water. Next is western wheatgrass (*Pascopyrum smithii*) habitat type and with six inches to no surface water. Last is the short-beaked sedge (*Carex simulata*) habitat type where the soil was moist.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water in the spring and occasionally from summer storms to this site.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as functional-at risk due to a dam intercepting water just above this wetland, intercepting water this wetland otherwise would have received. Cow pie coverage ranged from 01 to 10 and there was a three-inch stubble.

5036 Site 6 NE 2

LOCATION
Site survey 5036 Site 6 NE 2 is at T36N R31E Sec. 34 NE of NW. From Malta go north on 191 to the Whitewater turnoff and continue to Whitewater. From here go about six miles north and walk to the site.

RICHNESS
The very gently rolling uplands around this site have mostly been converted to crested wheatgrass (*Agropyron cristatum*) grassland. The wetland itself has two communities with a common spikesedge (*Eleocharis palustris*) habitat type with one inch to no surface water. The drier community is a western wheatgrass (*Pascopyrum smithii*) habitat type and the soil was saturated.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water in the spring to this wetland with occasional summer storms also providing some as with the past storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The condition of this site was rated as functional-at risk due to the abundance of *Agropyron cristatum* in the watershed. This species has a different growth form than the native grasses and may be altering the surface flow patterns. Smooth brome (*Bromus inermis*) is also present in the *Pascopyrum smithii*) community and appears to be expanding. There were no other exotic species. Cow pie coverage was 03 and there was a three-inch stubble height.

5036 Site 7 NE 2

LOCATION
Site survey 5036 Site 7 NE 2 is at T36N R31E Sec. 34 SW of NE. From Malta go north on 191 to the whitewater turnoff and continue to Whitewater. From here go about six miles to the north and then walk to the site.

RICHNESS
About half of the very gently rolling uplands for this site have been planted to crested wheatgrass (*Agropyron cristatum*) while the rest is blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grassland. The wetland has two communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest position and currently with ten inches of surface water to none. The next community is a western wheatgrass (*Pascopyrum smithii*) habitat type with a moist soil.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually in the spring supplies most of the water to this wetland with an occasional summer storm also supplying some.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as functional-at risk due to a large portion of its watershed being planted to *Agropyron cristatum*). This species has a different growth form than the native grasses and may be altering the surface runoff pattern to the wetland. No non-native plants were in the wetland. Cow pie coverage was 03 and there was a three-inch stubble height.

5038 Site 1 NE 3

LOCATION
Site survey 5038 Site 1 NE 3 is at T36N R30E Sec. 12 SW of SE. From Malta go north on 191 to the second Whitewater turnoff then go about 2.8 miles to where the road goes southeast and go about one more mile. Walk to the site from here.

RICHNESS
Very gently rolling terrain surrounds this site, which is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grassland. There is also a small amount of crested wheatgrass (*Agropyron cristatum*) present. Two wetlands are represented here with each having the same two communities. A common spikesedge (*Eleocharis palustris*) habitat type is in the wettest position while western wheatgrass (*Pascopyrum smithii*) is in the drier. The soil was dry when sampled.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and occasionally from summer storms.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. Cow pie coverage was 03 and no non-native plants were seen.

5035 Site 1 NE 3

LOCATION
Site survey 5035 Site 1 NE 3 is at T36N R31E Sec. 4 NW of SW. From Malta go north on 191 to the second Whitewater turnoff. From here go about 2.8 miles and the road will turn southeast and continue about one more mile. Walk to the site from here.

RICHNESS
The gently rolling uplands of this site are vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. This reservoir has three plant communities. The Canada waterweed (*Elodea canadensis*) community type occupies a pond in the lower end of the reservoir that probably never dries. Next is a sawatch knotweed (*Polygonum sawatchense*) dominance type and on the driest position a foxtail barley (*Hordeum jubatum*) community type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and at times from summer storms.

RARITY
No rare plants or plant communities were seen.

CONDITION
Proper functioning condition was the rating given to this site. Before construction of the dam, an upland grassland probably existed here. The communities found at this site are probably still adjusting to the new situation. The one non-native plant was red orache (*Atriplex rosea*). There were no cow pies in the aquatic community and the drier communities had a coverage of 01.

5013 Site 1 NE 3

LOCATION
Site survey 5013 Site 1 NE 3 is at T37N R31E Sec. 31 NW of NE. From Malta go north on 191 to the second turnoff for Whitewater. Go east about 2.8 miles to where the road turns southeast and continue for about one mile then walk to the site.

RICHNESS
The gently rolling uplands surrounding this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Two plant communities were found in the wetland with a foxtail barley (*Hordeum jubatum*) community type in the wettest position and a western wheatgrass (*Pascopyrum smithii*) habitat type in the dry portion.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site during the spring an occasionally from summer storms.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as functional-at risk due to a stock pond that was excavated into the bottom of the wetland. Water the wetland would get now goes into the pond. A common spikesedge (*Eleocharis palustris*) habitat type probably existed where the *Hordeum jubatum* community type now exists. Two non-native plants found here are crested wheatgrass (*Agropyron cristatum*) and fowl bluegrass (*Poa palustris*). The cow pie coverage varied form 01 to 03.

5013 Site 2 NE 3

LOCATION
Site survey 5013 Site 2 NE 3 is at T37N R31E Sec. 31 SW of NE. From Malta go north on 191 to the second Whitewater turnoff then go east about 2.8 miles to where the road goes southeast. Proceed about one more mile and walk to the site.

RICHNESS
Three wetlands are covered here and are surrounded by gently rolling terrain vegetated with blue grama (*Bouteloua gracilis*) and a needle-and-thread (*Hesperostipa comata*) grasslands. In the wetland the wettest site has a foxtail barley (*Hordeum jubatum*) community type and a western wheatgrass (*Pascopyrum smithii*) habitat type. Wetland two has the same communities while three only has the *Pascopyrum smithii* community.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water during the spring and occasionally from summer storms to these wetlands.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. Cow pie coverage was 03 and goat's beard (*Tragopogon dubius*) and Canada bluegrass (*Poa compressa*) were non-native plants at the site. The soil was dry. Stubble height was two to three inches.

5013 Site 3 NE 3

LOCATION
Site survey 5013 Site 3 NE 3 is at T36N R31E Sec. 5 SE of NE. From Malta go north on 191 to the second Whitewater turnoff and then go east for about 2.8 miles to where the road go south east. Go about another mile and walk to the site.

RICHNESS
Three wetlands are covered here. The site is surrounded by gently rolling terrain vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetlands only have one plant community, which is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water in the spring and occasionally from summer storms to these wetlands. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. Cow pie coverage was 01. Non-native plants were goat's beard (*Tragopogon dubius*) and fowl bluegrass (*Poa palustris*).

5015 Site 1 NE 4

LOCATION
Site survey 5015 Site 1 NE 4 is at T37N R32E Sec. 30 NE of NE. From Malta go north on 191 to the Whitewater turn off and go to Whitewater. The site is twelve miles to the north.

RICHNESS
Gently rolling terrain surrounds this site and is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. A portion of this upland was drilled to crested wheatgrass (*Agropyron cristatum*) a year or so ago but not very much came up. The wetland has two communities with a western wheatgrass (*Pascopyrum smithii*) habitat type in the wettest portion and a short-beaked sedge (*Carex simulata*) habitat type in the drier part.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and from occasional summer storms. The soil was moist when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as functional-at risk. A year or so back a portion of the upland was drilled to *Agropyron cristatum*. Water that would have flowed over the surface is now going to be intercepted by the seed drill furrows. Cow pie coverage was 01 and there were no non-native species.

5015 Site 2 NE 4

LOCATION
Site survey 5015 Site 2 NE 4 is at T37N R31E Sec. 26 SE of SE. From Malta go north on 191 to the whitewater turnoff and then go to Whitewater. The site is twelve miles to the north.

RICHNESS
The rolling uplands around this site were vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has one community, which is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this community in the spring an occasionally from summer storms. A recent storm has supplied up to ten inches of water.

RARITY
No rare plants or rare plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. There were no non-native plant species and the cow pie coverage was 03.

5015 Site 3 NE 4

LOCATION
Site survey 5015 Site 3 NE 4 is at T34N R31E Sec. 26 SW of NE. From Malta go north on 191 to the Whitewater turnoff and proceed to Whitewater. The site is twelve miles to the north.

RICHNESS
The rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. With this wetland two communities were sampled. The wettest one is a common spike sedge (*Eleocharis palustris*) habitat type and in the drier portion a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water to this site in the spring and from the occasional summer storm. At the time of sampling up to seven inches of water was present.

RARITY
No rare plants or plant communities were present.

CONDITION
The site was rated as being functional-at risk. A stock pond has been dug into the wetland take water the wetland would otherwise get. Cow pie coverage ranged from 03 to 10 and goat's beard (*Tragopogon dubius*) was the only non-native species.

5015 Site 4 NE 4

LOCATION
Site survey 5015 Site 4 NE 4 is at T37N R31E Sec. 26 NE of SW. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. The site is twelve miles to the north.

RICHNESS
Pea Lake is a very large wetland that is surrounded with rolling uplands probably mostly vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Three wetland communities were sampled here with a foxtail barley (*Hordeum jubatum*) community type in the wettest spot, then a common spikesedge (*Eleocharis palustris*) habitat type, and in the driest portion a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most the water to this wetland in the spring and at times from summer storms. The soil was saturated from recent storms when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as functional-at risk due to the presence of numerous reservoirs in the headwaters. Pea Lake is in a natural basin. A dam was built in an effort to convert a part of this wetland basin into farmland. Cow pie coverage ranged from 01 to 03. A non-native plant was summer cypress (*Kochia scoparia*) with a coverage of 03.

5014 Site 1 NE 5

LOCATION
Site survey 5014 Site 1 NE 5 is at T37N R31E Sec. 7 SW of SE. From Malta go north on 191 to the second Whitewater turnoff. Go east on this road to a county road on the left. Follow this road north and then east to the end. Ask the landowner for access.

RICHNESS
The uplands surrounding this community are vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. In the wetland there are three communities. The wettest is a willow dock (*Rumex salicifolius*) dominance type located in the bottom of the waterfowl enhancement moat. The next is a foxtail barley (*Hordeum jubatum*) community type on the sides of the moat. The driest is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and at times from summer storms. There was a small amount of water in a portion of the moat.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as functional-at risk due to the presence of the wildlife improvement structure that is removing water the wetland would otherwise get. Cow pie coverage varied form 01 to 03. Non-native plants were bull thistle (*Cirsium vulgare*) and wild lettuce (*Lactuca* spp.). Both of these were on the wildlife habitat structure with a coverage of 01 and 10.

5014 Site 2 NE 5

LOCATION
Site survey 5014 Site 2 NE 5 is at T37N R31E Sec. 7 NE of SW. From Malta go north to the second Whitewater turnoff. Then go east for two miles then north and east on a county road. Ask for access at the ranch where the road ends.

RICHNESS
The very gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has two communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest position and a western wheatgrass (*Pascopyrum smithii*) habitat type in the drier portion.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water to this wetland in the spring and from the occasional summer storm. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. There were no non-native plant species and the cow pie coverage ranged from 01 to 03.

5014 Site 3 NE 5

LOCATION
Site survey 5014 Site 3 NE 5 is at T37N R31E Sec. 7 SE of SE. From Malta go north on 191 to the second Whitewater turnoff. From here go east two miles then north and east on a county road to a ranch and ask for access.

RICHNESS
The very gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Four wetlands are covered here all with the same community, which is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and at times from summer storms. The soil was dry when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
All four of these wetlands were rated as being in proper functioning condition. There were no non-native plants and the cow pie coverage was 01.

5014 Site 4 NE 5

LOCATION
Site survey 5014 Site 4 NE 5 is at T37N R31E Sec. 18 SW of NE. From Malta go north on 191 to the second Whitewater turnoff. From here go east for two miles then north and east to a ranch and ask for access.

RICHNESS
The very gently rolling landscape around this site is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has three communities with the wettest being a common spikesedge (*Eleocharis palustris*) habitat type. Next is a foxtail barley (*Hordeum jubatum*) community type and the driest community is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and from the occasional summer storm. The soil was dry when sampled. Water can get about four feet deep in this wetland before over flowing.

RARITY
No rare plants or plant communities were seen.

CONDITION
The wetland was rated as being in proper functioning condition. Cow pie coverage was 01 and there were no non-native plants.

5014 Site 5 NE 5

LOCATION
Site survey 5014 Site 5 NE 5 is at T37N R31E Sec. 18 SW of NW. From Malta go north on 191 to the second Whitewater turnoff. Go east on this road for about two miles and then north and east on a county road. Ask at the ranch at the end of this road for access.

RICHNESS
The gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has three communities with the wettest being aquatic with a leafy pondweed (*Potamogeton foliosus*) community type. The other two are foxtail barley (*Hordeum jubatum*) community type and a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring in occasionally from summer storms. The soil was dry except for the aquatic community.

RARITY
No rare plants are plant communities were seen.

CONDITION
The site was rated as functional-at risk due the presence of a stock pond dug into the wetland that is taking water the wetland would otherwise get. Cow pie coverage was 0 in the aquatic portion and ranged from 01 to 03 in the rest of the wetland. A non-native plant found here was Loesel tumblemustard (*Sisymbrium loeselii*).

5069 Site 1 SW 1

LOCATION
Site survey 5069 Site 1 SW 1 is at T35N R32E Sec. 3 NE of NE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go east on a county road about five miles and then north on another county road about six miles. Walk to the site from here.

RICHNESS
The rolling uplands surrounding this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The portion of this large wetland has two communities with a common spike sedge (*Eleocharis palustris*) habitat type in the wetter portion and a western wheatgrass (*Pascopyrum smithii*) habitat type in the drier parts.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and from occasional summer storms. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition even though there was a stocky pond at its lower end. The volume of water the stock pond needs to fill appeared to be insignificant to the size of the wetland. Cow pie coverage was 03 and stubble height varied from two to five inches. Goat's beard was the only non-native plant seen.

5069 Site 2 SW 1

LOCATION
Site survey 5069 Site 2 SW 1 is at T35N R32E Sec. 3 NW of NE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go five miles east on a county road and then north on another county road about six miles. Walk to the site from here.

RICHNESS
The very gently rolling uplands surrounding this wetland are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Pascopyrum smithii*). The wetland has two bands of vegetation with no species in common between but only one habitat type, which is common spikesedge (*Eleocharis palustris*).

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and occasionally from summer storms. Water can get about ten inches deep before it overflows. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage ranged from 01 to 03 and there were no non-native plant species.

5069 Site 3 SW 1

LOCATION
Site survey 5069 Site 3 SW 1 is at T35N R32E Sec. NE of SW. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go five miles east on a county road and then about six miles north on another county road. Walk to the site from here.

RICHNESS
Most of the gentle undulating uplands have blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. However a portion has been planted to crested wheatgrass (*Agropyron cristatum*). The wetland has two plant communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wetter position and a western wheatgrass (*Pascopyrum smithii*) in the drier.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water to this site in the spring and from the occasional summer storm. The soil is moist from such a storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition even though a portion of its watershed has been plant to *Agropyron cristatum*. Cow pie coverage varied from 01 to 03 and there was a four-inch stubble. Common dandelion (*Taraxacum officinale*) was the only non-native plant seen.

5066 Site 1 SW 1

LOCATION
Site survey 5066 Site 1 SW 1 is at T36N R32E Sec. 3 NW of SE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go about five miles east on a county road and then about six miles north on another county road. Walk to the site.

RICHNESS
Most of the surrounding gently rolling uplands are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*). A portion, however, has been planted to crested wheatgrass (*Agropyron cristatum*). The wetland itself has two communities with common spikesedge (*Eleocharis palustris*) in the wetter portion and a narrow band of western wheatgrass (*Pascopyrum smithii*) in the drier.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water that this wetland receives in the spring and at times from summer storms. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as functional-at risk. A stock pond has been dug into the wetland, taking some of the water the wetland would otherwise receive. Also a portion of the watershed has been converted to *Agropyron cristatum*, which may alter the surface runoff pattern. Cow pie coverage varied from 01 to 03 and no non-native plant species were seen.

5066 Site 2 SW 1

LOCATION
Site location 5066 Site 2 SW 1 is at T36N R32E Sec. 32 NE of SE. From Malta go north on 191 to the Whitewater turnoff and then go to Whitewater. From here go about five miles east on a county road and then about six miles north on another county road. Walk to the site.

RICHNESS
The very gently rolling uplands surrounding this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Two wetlands are covered here both with the same plant communities. Two plant communities are in these wetlands with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest part and a western wheatgrass (*Pascopyrum smithii*) habitat type on the drier part.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland is rated as being in proper functioning condition. Cow pie coverage was 03 and there were no non-native plants.

5068 Site 1 SW 1

LOCATION
Site survey 5068 Site 1 SW 1 is at T36N R32E Sec. 32 NE of SE. From Malta go north on 191 to the White water turnoff and go to Whitewater. From here go east for about five miles on a county road and then go north on another county road for about six miles. Walk to the site.

RICHNESS
The very gently rolling terrain surrounding these two wetlands is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Both wetlands had two plant communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest position and a western wheatgrass (*Pascopyrum smithii*) habitat type in the drier.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to these wetlands in the spring and during the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
Both wetlands were rated as being in proper functioning condition. Cow pie coverage ranged from 01 to 03 and field cottonrose (*Logfia arvensis*) with a coverage of 01 was the only non-native plant.

5034 Site 1 SW 1

LOCATION
Site survey 5034 Site 1 SW 1 is at T36N R32E Sec. 33 NW of SE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go east for about five miles to a county road and then go north for about six miles. Walk to the site.

RICHNESS
The very gently rolling terrain surrounding these two wetlands is vegetated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetlands have two communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wetter portion and in the drier part a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. Cow pie coverage ranged from 01 to 03 and common dandelion (*Taraxacum officinale*) and goat's beard (*Tragopogon dubius*) both with a coverage of 01 were the only non-native plants seen.

5034 Site 2 SW 1

LOCATION
Site survey 5034 Site 2 SW 1 is at T36N R32E Sec. 37 NW of NE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here take a county road east about five miles and then a county road north about six miles. Walk to the site.

RICHNESS
The very gently rolling uplands surrounding this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has three plant communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest area, then a foxtail barley (*Hordeum jubatum*) community type, and in the driest portion a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water for this wetland in the spring and occasionally from summer storms. The soil was saturated in the *Eleocharis palustris* community and moist in the other two.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as being in proper functioning condition. Cow pie coverage ranged form 01 to 03. Non-native plants found here were Canada bluegrass (*Poa compressa*) and goat's beard (*Tragopogon dubius*) both with a coverage of 01.

5086 Site 1 SW 2

LOCATION
Site survey 5086 Site 1 SW 2 is at T35N R32E Sec. 31 SE of SW. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go about two and a quarter miles east to a small road to the south. Walk to the site from here.

RICHNESS
The very gently undulating terrain here is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Ten small wetlands are covered here all with the same plant community, which is a western wheatgrass (*Pascopyrum smithii*) habitat type. For some reason wetland one was the only one of the bunch without a forb component.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being in proper functioning condition. Cow pie coverage was 03 and there were no non-native plant species.

5085 Site 1 SW 2

LOCATION
Site survey 5085 Site 1 SW 2 is at T34N R32E Sec. 7 NE of NE. From Malta go north on 191 to the Whitewater turnoff and proceed to Whitewater. From here go about two and a quarter miles east to a small road to the south and walk from here.

RICHNESS
Three wetlands in very gently undulating terrain are represented here. The upland area is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetlands have two communities with a common spikesedge (*Eleocharis palustris*) habitat type being in the wettest position and a western wheatgrass (*Pascopyrum smithii*) habitat type in the drier portions.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and from the occasional summer storms. The soil was moist from a recent summer storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage varied from 01 to 03 and goat's beard (*Tragopogon dubius*) and common dandelion (*Taraxacum officinale*) both with a coverage of 01 were the only non-native plants seen.

5085 Site 2 SW 2

LOCATION
Site survey 5085 Site 2 SW 2 is at T34N R32E Sec. 8 NW of NW. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go about two and a quarter miles to a small road to the south. Walk to the site.

RICHNESS
This large wetland is bordered by gently rolling terrain vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. One plant community was found here, a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water for this wetland in the spring and during the occasional summer storm. The soil was moist when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as being in proper functioning condition, at least on the BLM portion. A portion of this wetland on private ground has been converted to cropland. Pugging from a few years back was also evident but may be more related to the soils than grazing. Cow pie coverage was 03. No non-native plants were seen.

5085 Site 3 SW 2

LOCATION
Site survey 5085 Site 3 SW 2 is at T34N R32E Sec. 7 SW of NE. From Malta go north on 191 to the Whitewater turnoff and go to Whitewater. From here go about two and a quarter miles to a small road to the south. Walk to the site.

RICHNESS
The very gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland had three communities with the wettest being a slimleaf goosefoot (*Chenopodium leptophyllum*) dominance type where the water can get about three feet deep, next is a common spikesedge (*Eleocharis palustris*) habitat type, and on the driest portion a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The wetland was rated as being in proper functioning condition. Cow pie coverage ranged from 01 to 03 and there were four non-native plant species, common dandelion (*Taraxacum officinale*), goat's beard (*Tragopogon dubius*), summer cypress (*Kochia scoparia*), and wild lettuce (*Lactuca* spp). None of these species had a coverage greater than 03.

5086 Site 2 SW 2

LOCATION
Site survey 5086 Site 2 SW 2 is at T34N R31E Sec. 1 NE of SE. From Malta go north on 191 to the Whitewater turnoff and then go to Whitewater. From here go about two and a quarter miles to a small road to the south. Walk from here.

RICHNESS
This site is surrounded by gently rolling uplands dominated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. This wetland has three communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest area, then a western wheatgrass (*Pascopyrum smithii*) habitat type, and in the driest portions a short-beaked sedge (*Carex simulata*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually supplies most of the water to this wetland in the spring and from the occasional summer storm. The soil was moist when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The wetland was rated as being in proper functioning condition. Cow pie coverage varied from 01 to 03 and goat's beard (*Tragopogon dubius*) was the only non-native plant with a coverage of 01.

5062 Site 1 SW 3

LOCATION
Site survey 5062 Site 1 SW 3 is at T34N R31E Sec. 3 NE of SE. From Malta go north on 191 to the Whitewater turnoff and then go within three miles south of Whitewater. Walk to the site from here.

RICHNESS
The very gently undulating uplands are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Three wetlands are covered here with only one plant community present, which is a western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to these wetlands in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage was 03 and there were no non-native plant species.

5062 Site 2 SW 3

LOCATION
Site survey 5062 Site 2 SW 3 is at T34N R31E Sec. 3 NE of SW. From Malta go north on 191 to the Whitewater turnoff and stop about three miles south of Whitewater. Walk to the site from here.

RICHNESS
The very gently rolling terrain is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Only one community was seen in this large wetland, which is a western wheatgrass (*Pascopyrum smithii*) habitat type,

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functional condition. Cow pie coverage was 01 and there was pugging from probably last year. There were no non-native plant species.

5087 Site 1 SW 4

LOCATION
Site survey 5087 Site 1 SW 4 is at T34N R32E Sec. 30 SE of SE. From Malta go north on 191 to the Whitewater turnoff. From here go towards Whitewater and go west at the boys ranch road. Go to the boys ranch.

RICHNESS
Gently rolling terrain surrounds this wetland and it is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Two plant communities are found in this wetland with a common spikesedge (*Eleocharis palustris*) in the wettest position and western wheatgrass (*Pascopyrum smithii*) in the drier portion.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this site in the spring and from the occasional summer storm. The stock pond in this wetland was dry but the soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
This site was rated as being functional-at risk due to a large stock pond dug into the wetland. Water the wetland once received now goes into this pond. Upland plants appear to be moving into the site. Cow pie coverage is 03 and there is some pugging from last year. No non-native plants were seen.

5087 Site 2 SW 4

LOCATION
Site survey 5087 Site 2 SW 4 is at T34N R32E Sec. 30 NW of NE. From Malta go north on 191 to the Whitewater turnoff. Go towards Whitewater and turn right at the boys ranch road. Go to the boys ranch.

RICHNESS
The very gently rolling uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Three communities were in the wetland with a foxtail barley (*Hordeum jubatum*) community type in the wettest position, then a common spikesedge (*Eleocharis palustris*) habitat type, and in the driest portion western wheatgrass (*Pascopyrum smithii*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff provides most of the water to this site in the spring and from the occasional summer storm. The soil was moist from a recent storm.

RARITY
No rare plants or plant communities were seen.

CONDITION
The site was rated as being in proper functioning condition. Cow pie coverage varied from 01 to 03 and there was some pugging but probably no more than when the bison were around. Goat's beard was the only non-native plant species with a coverage of 01.

5087 Site 3 SW 4

LOCATION
Site survey 5087 Site 3 SW 4 is at T34N R32E Sec. 33 SW of NW. From Malta go north on 191 to the Whitewater turnoff and go towards Whitewater. Turn off at the boys ranch and follow the road to the ranch and ask for access.

RICHNESS
The very gently undulating uplands around this site are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. Two communities are found in the wetland. A foxtail barley (*Hordeum jubatum*) community type is in the wettest portion and a western wheatgrass (*Pascopyrum smithii*) habitat type is in the drier portion. The photo of the site shows the polygon cracks that are commonly found in the *Pascopyrum smithii* community. The cracks are about six inches deep and when the site is dry small mammals use them for homes. The cracks did not close when some of the sites flooded.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and occasionally from summer storms. The soil was moist from a recent storm. In wet years water may get to three feet deep before overflowing.

RARITY
No rare plants or plant communities were seen.

CONDITION
The wetland was rated as being in proper functioning condition. Cow pie coverage varied from 01 to 03 and the stubble height in the *Pascopyrum smithii* community was six inches.

5089 Site 1 SW 4

LOCATION
Site survey 5089 Site 1 SW 4 is at T34N R32E Sec. 7 NW of NE. From Malta go north on 191 to the Whitewater turnoff and go towards Whitewater. Turn off at the boys ranch and proceed to the ranch. Ask for access.

RICHNESS
The very gently undulating uplands are vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has three community bands with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest position. Next is another (*Eleocharis palustris*) habitat type but it has different plant species component with needle spikerush (*Eleocharis acicularis*) being the dominant species. In the driest position is a short-beaked sedge (*Carex simulata*) habitat type.

KEY ENVIRONMENTAL FACTORS
The gently rolling terrain surrounding this site is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The soil was moist when sampled.

RARITY
No rare plants or plant communities were seen.

CONDITION
The wetland was rated as functional-at risk due to a stock pond at one end. Water than would have flooded the wetland now goes into this pond that was dry at the time of the site visit. The wetland also appears to be drier than it once was. Cow pie coverage varied from 03 to 10 and there was a small amount of pugging.

5089 Site 2 SW 4

LOCATION
Site survey 5089 Site 2 SW 4 is at T34N R32E Sec. 6 SE of NE. From Malta go north on 191 to the Whitewater turnoff and go towards Whitewater. Before getting there turn at the boys ranch and go to the ranch. Ask at the ranch for access.

RICHNESS
This wetland is surrounded by a very gently rolling terrain that is dominated by blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland has three plant communities with a common spikesedge (*Eleocharis palustris*) habitat type in the wettest position, then a western wheatgrass (*Pascopyrum smithii*) habitat type, and a short-beaked sedge (*Carex simulata*) habitat type in the driest portion.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this wetland in the spring and from the occasional summer storms. The soil was moist when sampled. There may be no outlet for this wetland.

RARITY
No rare plants or plant communities were seen.

CONDITION
This wetland was rated as being in proper functioning condition. Cow pie coverage was 03 and goat's beard (*Tragopogon dubius*) was the only non-native plant species with a coverage of 01.

5089 Site 3 SW 4

LOCATION
Site survey 5089 Site 3 SW 4 is at T34N R32E Sec. 6 NE of NE. From Malta go north on 191 to the Whitewater turnoff and go towards Whitewater. Before getting there turn of on the road to the boys ranch and go there. Ask at the ranch for access.

RICHNESS
This wetland is surrounded by very gently rolling terrain that is vegetated with blue grama (*Bouteloua gracilis*) and needle-and-thread (*Hesperostipa comata*) grasslands. The wetland itself has three plant communities with a slimleaf goosefoot (*Chenopodium leptophyllum*) dominance type, then a western wheatgrass (*Pascopyrum smithii*) habitat type, and in the dries portion a short-beaked sedge (*Carex simulata*) habitat type.

KEY ENVIRONMENTAL FACTORS
Surface runoff usually provides most of the water to this woodland in the spring and form the occasional summer storm. The soil was moist from a recent summer storm and the wetland my not have an outlet. The wettest community has 60 percent bare ground. It could be that the water stays too long during the growing season or is too deep or both for perennials to dominate the site.

RARITY
No rare plants or plant communities were seen.

CONDITION
The wetland was rated as being in proper functioning condition. Cow pie coverage varied from 01 to 03. The only non-native plant was Russian thistle (*Salsola kali*) with a coverage of 01.